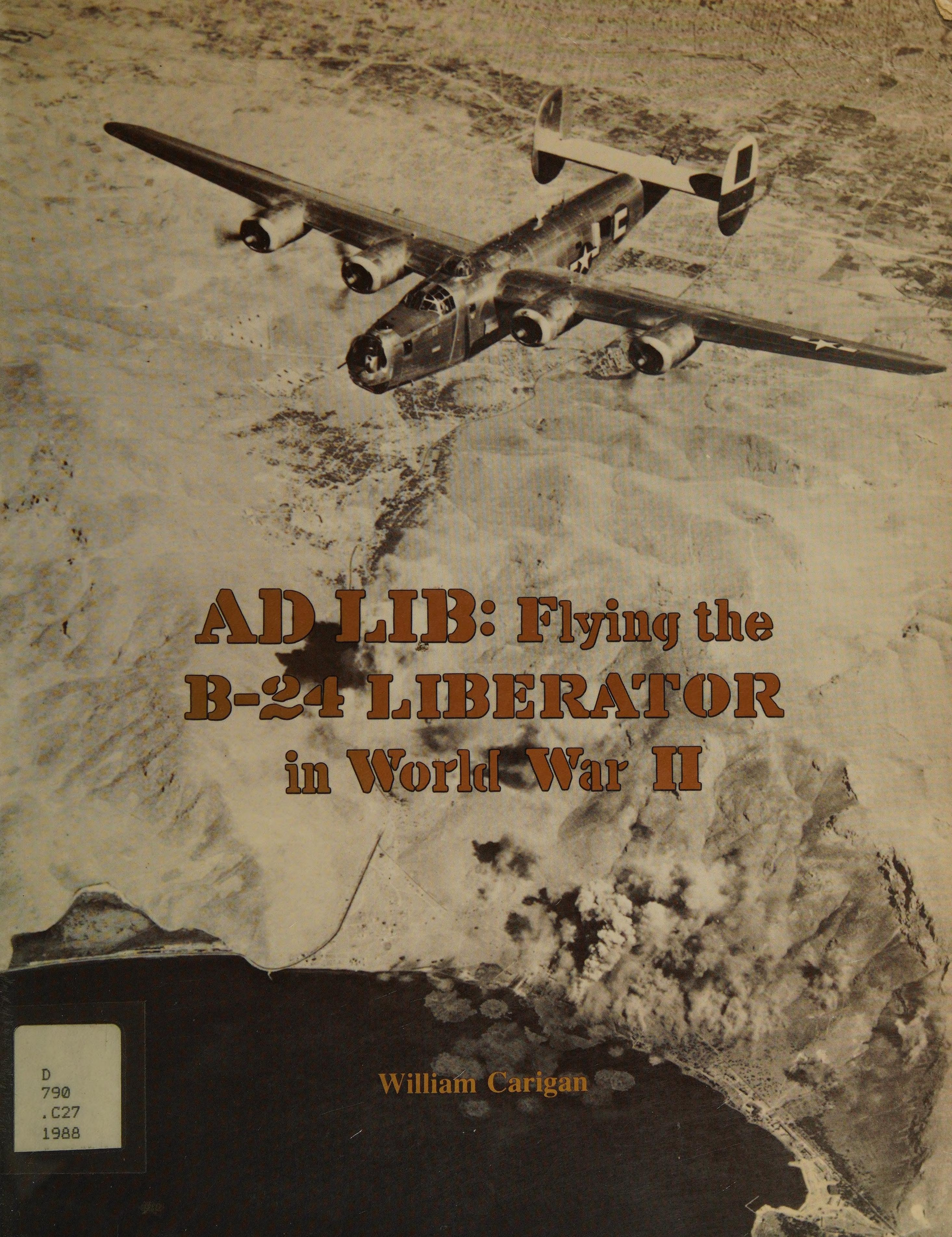
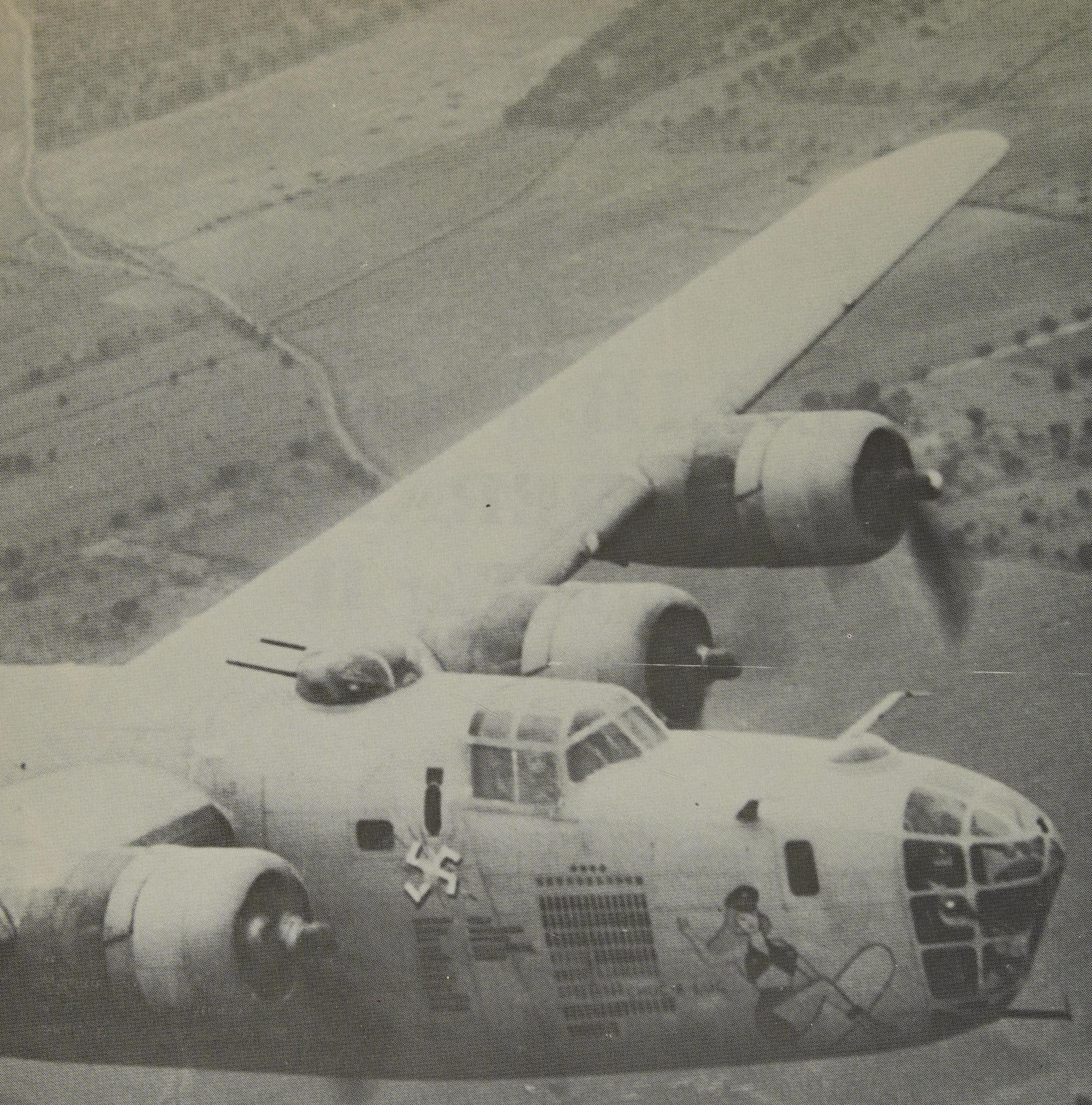


AD LIB: Flying the B-24 LIBERATOR in World War II

William Carigan

D
790
.C27
1988

AD LIB: Flying the B-24 LIBERATOR in World War II



3 3501 00010 3885

AD LIB: Flying the B-24 LIBERATOR in World War II

William Carigan

WITHDRAWN
SOUTHEASTERN OHIO REGIONAL LIBRARY
40780 STATE ROUTE 821
CALDWELL, OHIO 43724

Sunflower University Press®
1531 Yuma (P.O. Box 1009)
Manhattan, Kansas 66502-4228

Copyright 1988 by
Sunflower University Press
ISBN 0-89745-099-X

Design by: Deb Wilds

Cover Photo: A B-24 with combat organization markings.

91-11241

Contents

Preface 7

Introduction 9

1 Another Fine Mess 11
Training — Personnel — Equipment — Inspection

2 Checklist, Semper Fi 17
Before starting engines — Starting — Before taxying

3 Taxying and Takeoff 25
Engine run-up — Takeoff — The Climb — Leveling off — Sychronizing propellers — Trimming

4 Cruising 39
Flight characteristics — Flight restrictions — Airspeed — Stalls — Turns

5 Landings 47
Landing checks and techniques — Landing roll — Parking Go-around — Short-field landings — Low-visibility approach

6 Emergencies 59
Forced landings — Fire — Engine failure

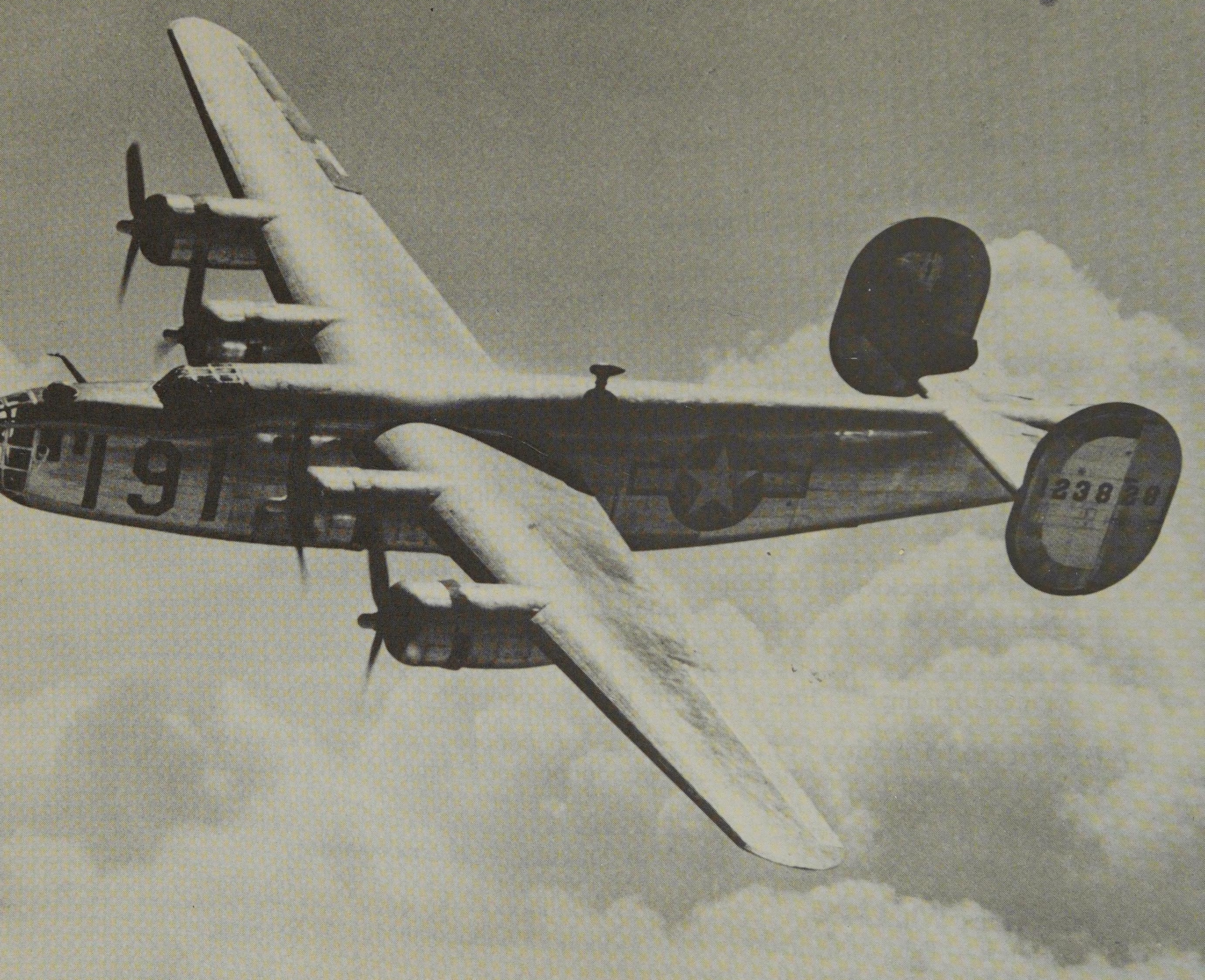
7 Bailout and Ditching 67
When to bail out — Signals — Procedures — Ditching — Survival

8 Forming the Aircrews 73
The Liberator: A fading memory — Training — Journey to Italy

9 Who Does What 87
Rules — Duty assignments — Armament — Combat bases — Briefing — The Mission — Return to base

Appendix A: General Specifications for the B-24 97

Appendix B: Pilot's Checklist 99


238 20

Preface

Flying has long been for me a favorite way of having fun, but the reality was rougher than the romantic vision. First, for example, was the fact that it got colder as I went higher. Icarus, the son of Daedalus, found it got hotter as he went higher until the sun's heat melted the wax that kept his wing feathers attached, and he fell into the sea. Old Daedalus the steady was successful, though not as romantically appealing somehow. When I started into the flying game, I resolved not to do as Icarus had done — just have fun. My country needed flyers, so perhaps I could strike an ideal balance: do something for my country and enjoy flying at one blow.

I enjoyed it, but I found less than ideal moments all along the way. Air work turned out to be air *work*. Where I thought it would be all chandelles and slow rolls, buzzing on the way home, it was sweating under an instrument hood, or pushing and pulling an airplane for hours, or trying to hit my prop wash at the end of a 360-degree steep turn — but enough of the thorny parts. When I perfected my technique, found warm clothes, and got assigned a bird easy on the controls, then all would be sweetness and light. Irony.

Along came the B-24.

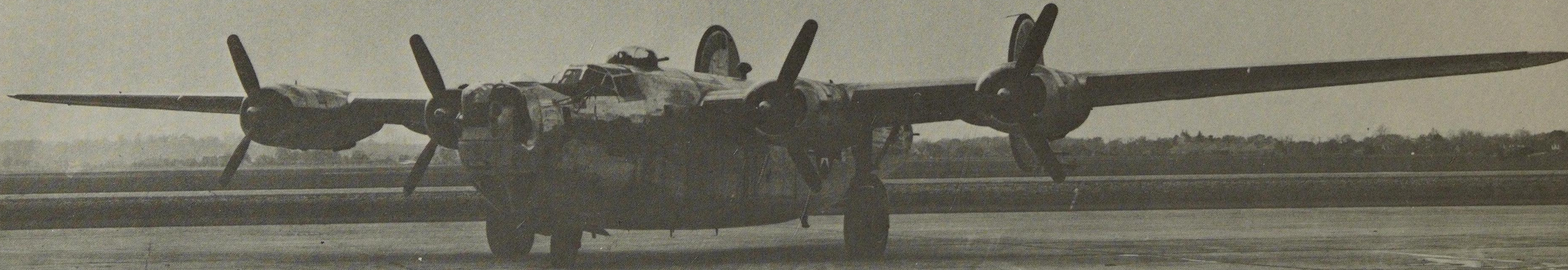
Never was I a super flyer. My credentials for writing this book consist, in part, of flying the B-24 in combat, completing the Four-Engine Instructors' School, and studying everything I could about the B-24. Then the war ended and the Army Air Forces immediately scrapped the B-24. So I knew nearly all about nothing. Additionally, I had a good memory, and I liked to tell a story. Robin Higham, Editor of *Aerospace Historian*, once suggested that I should write about World War II airplanes — that when I died, the history and personal knowledge I hadn't written would be lost. I thought about his words; so, good or bad or useless, I tell here some facts and true tales about that great old warbird, the B-24.

For authority I have relied on Technical Order AN 01-5EE-1, 30 November 1944, Pilot's Flight Operating Instructions for the B-24G, H, and J. I have followed the *Pilot Training Manual for the Liberator, B-24*, published by Headquarters, AAF, 1944, with deviations and comments of my own or of Phil Ardery, a B-24 pilot; or of Tom Balmer, who taught me to stay off the brakes; or of Bob Vincent, who endured flying school and the Liberator with me. Hank Thorne taught me a great deal about the duties of and to a wing man when he pulled me out of a quicksand in Iceland, and Chesley Peterson of Eagle Squadron fame illuminatingly demonstrated self-reliance. And . . . but if I start a list of debts it will be like the Chronicles or the Begats, after which somebody will tell me I forgot to list my mother, or Keith Moore or Dusty Buttrill. Yet I must mention the Air Force — that bunch put me into the great birds — and Lt. June Green of the Air Force Office of Public Affairs, who helped me get pictures of the Liberator from the Air and Space Museum.

In those days of deep memory — World War II — there were giants in the earth. If the giants were not already in the earth, we put many there, many whose like we shall not see again. Death was surely too much there for both sides, necessary most often in combat operations but always regretted. On a mission designed to spill Wehrmacht blood, SS type, we executed better than we knew. One day in the faculty lounge at Utah State University, I was pressed to comment on that gory mission. I did, then rose and returned to my office, followed closely by a young professor who apparently was shaken by the story. "Are you," he demanded, "proud of all that killing?" After a pause I answered, "Oh, no." He waited, uncertain. I concluded, "But I am proud that I didn't let my country down."

I think this book is simple enough for flyers and those who love flying to understand; just remember that rpm means revolutions per minute.

God bless all flyers, especially those I have known. Someday we'll pull a log up to the story fire and tell of stirring deeds. To those who don't care for the flying game, I dedicate all the bad parts of this work.



Introduction

Whatever else it is, the B-24 Liberator is a man's airplane, sternly unforgiving and demanding sometimes super strength, always requiring considerable muscle. Heavy on the controls, the airplane tires the strongest teams of pilots on long missions. With an engine feathered, the airplane requires constant pressure on the opposite rudder pedal, in addition to full trim tab. If the feathered engine is an outboard, number one or number four, the required push by the pilot is startingly more. When you are, say, five hours from the nearest friendly base, the prospect is dismaying. Holding the pressure steadily on the rudder pedal for half an hour to forty-five minutes sets the best-conditioned pilot's leg to trembling with fatigue. At such a time the resourceful pilot will simply move the other foot over and apply pressure with it while resting the first. After perhaps another half hour, the weary pilot puts both feet on the rudder pedal for the next half hour. Now both legs are trembling. Our hero, by necessity, thinks creatively in this dire extremity and comes up with a clever reversal of pressure. He simply hooks a foot under the other pedal and pulls. When this leg starts trembling again, he changes feet, pulling with the other foot. Going through the whole routine again will work, but for ever shorter periods. When no strength remains in either leg, our exhausted airplane driver should wake up Leroy (the copilot), if that flap jockey is operative. When the copilot is unable to help, the desperate pilot resorts to a last-ditch measure. He reduces the power on the opposite outboard engine.

Not ideal procedure. When the aircraft commander reduces power, he further reduces his already low airspeed. He is still three or more hours from the nearest runway and by slowing has extended the remaining flying time by perhaps another half hour. It is already a bad day, and the wearer of the silver wings wonders why he ever took up flying.

Well, he rests a little, then pushes the power back up and goes through the left-right-both push and the left-right pull sequences again, but the limits of endurance in each position are now much shorter. Though the pilot usually dislikes the idea, he has the crew lift the inoperative copilot from his seat and replaces him with the flight engineer, who helps. Ah.

With luck, the aircraft is now at low-enough altitude for the pilot to remove his oxygen mask, smoke if he has 'em, and reflect on the glamor of his calling, meanwhile administering morphine to those who need it. But don't relax too much. Here come the unfriendly fighters, a revolting development that forces the effort at getting back into formation — any friendly formation — and which means the pilot must get back to work. But assuming luck, friendly fighters, a lightening airplane, and the lovely, blue Adriatic ahead, the pilot begins to believe that home is reachable. If he reaches that runway, he'll probably drink his mission drink in one gulp, tell a wild story at interrogation (now called debriefing), and fly another day.

In the unlikely event that you ever fly a B-24 again, hope that you never lose an engine on takeoff, especially, heaven forbid, not an outboard or — name of the devil — not number one.

It has been widely reported that combat-loaded B-24s are not controllable on takeoff without number-one engine; if one happens to be taking off from Italian gravel and dirt, control makes no difference, for the aircraft's moments are numbered anyway.

Still, a man must try. Survival foremost in your awareness, feather the engine (the proper one, or that girl will cry) and run the emergency checklist rapidly. At an airspeed in excess of 100 mph — about 130 will give you a chance — and the runway mostly behind, flight must be attempted. Here heavy pressure is necessary — and how — and I mean, baby, a heavy foot on the right rudder. For most pilots, an operative copilot is a must to help on the rudder, to get up the gear, and to milk the flaps up to eight degrees, as the NOV 44 technical order reads (no earlier technical orders touch at all on this little nicety). I can testify that twelve degrees will work on a warm, Italian, summer's day. Here too is the best time to use all the available power. In spite of the direst probabilities, let us assume that your takeoff is successful; the whole pattern may successfully be flown if you avoid racking the airplane up into a steep turn into the dead engine. Believe it, this latter maneuver can put all your flying problems behind you.

– from "The B-24 Liberator: A Man's Airplane"
*(**Aerospace Historian**, March 1988)*

251972
72 -

1
Another Fine Mess

Here I sit in the left seat of a B-24, in takeoff position; an instructor, a patient one, is in the right seat, trying to keep a straight face. How did I get here? What will happen next? Probably I am facing yet another moment of truth. But excitement rides me, anticipation, and of course, tension. Through this gleaming arch lies a new world; here we might look back to guess what lies beyond the arch.

Before World War II, this southern lad had never been in an airplane. Nobody suggested that I try the flying game, and it all seemed remote until a cohort said, "We should be up there." A pair of P-38 Lightnings hummed overhead; we were slogging along a Virginia dirt road in hottest summer, I carrying full field pack and two Springfield rifles (one for a soldier with bleeding feet, one for an exhausted rookie). Highly suggestible at that moment, I fell in with the serpent who urged the idea. Application, physical examination, and messages followed. At last I was ordered to Santa Ana, California, for preflight training, where it was fun and anticipation. On to Primary Flying School at Rankin Aero Academy, Tulare, California — higher anticipation still — until I found myself in the rear seat of an open-cockpit biplane, the famous Stearman Primary Trainer. I wore a leather flying jacket, a white scarf, helmet, goggles and a summer-flying suit, and sat on a seat-type parachute. My cool instructor spoke calmly and authoritatively through the Gosport tube. "Now we advance the throttle and take off." Soon I felt the softness of air under me instead of the firmness of earth; steadily the Stearman climbed, the instructor explaining everything and telling me to follow lightly on the controls. Around we went and the instructor continued, "Downwind leg in our landing pattern, now the base leg. Now we turn on our final approach."

Dear God in Heaven, I thought. And on my first flight. So this is how I win my wings.

Fortunately, the instructor was in error. There was, mercifully, more flying for me, and I still have not made my final approach. Basic training at Marana, Arizona, followed; then came advanced twin-engine training at Marfa, Texas. Now I was ready for P-38s, so the AAF sent me to Hammer Field at Fresno, California. All a wing o' the wisp. The powers decreed Muroc, California (now Edwards AF Base), the right seat of a B-24, and the course in Combat Phase Training. Oh, well, my country needed me. Aside from that, I got to know Pancho Barnes. Eternally worth it.

So there I was, lined up on the runway, ready to push through the next arch of experience. I mashed the throttles forward, the forty-eight hundred horses cleared their throats, the earth shook beneath me, and I was hooked for the next twenty-five years.

Back a moment to the road to this fine mess that Elias West got me into. Down from Fresno, across into the Mohave Desert, and on to Muroc at a time of year when Rogers Dry Lake wasn't dry. As I drove into the base I saw B-24s flying about, big as life. Still, it was possibly an illusion accomplished with mirrors and blue smoke, to what purpose I didn't know unless the gods of irony were setting up a big joke, just to laugh at me as I tried to extricate myself from all this. In any case, I was drawn to the tiller by the siren songs of the Flying Game. So study.

Technical Orders were useful; Consolidated Aircraft's films helped. Training manuals shed light on components. Ground school brought the chance to ask questions, to peer into mock-ups. Reluctantly, I admitted, it may all be real. Still, differences in instructions signaled that the perpetrators of this hoax didn't have their procedures together.

Which checklist to believe? Which film? Some bad writing, some ignorance, I finally concluded, caused the conflicting instructions. If I can survive the bad instructions, I reasoned, I might put the experts on the right track. Even the last tech order for pilots had numerous errors and, wherever possible, contained ambiguous instructions. So, forward, and let the rough end drag. Study as if you were to live forever (my steady intention). Listen. Ask.

We started with war-weary B-24Ds, operating on 91-octane fuel and supercharged with hydraulic turbo controls — we called them oil-line turbos — all of which I'll touch on further, later. Four engines, remember. Troubles times four or safety times four?

New B-24s on a stateside ramp. These aircraft with the nose turrets delivered the major blows against fortress Europe and many targets in the Pacific and the Orient.

Think positively as you approach this heavy bomber, approach the oval nacelles lying lazily on their sides, approach with the pilot's inspection procedures memorized, whether or not understood.

The four compartments (five if you consider the tail turret a fifth, though why?) start with the bombardier-navigator's compartment, where these two operators operate. The nose-turret gunner makes three. Next follows the flight deck, with which we'll primarily concern ourselves, where the pilot sits on the left, the copilot on the right, the flight engineer standing, for most operations, aft of the pilot's pedestal. On some early models, the radio operator was stationed aft of the copilot. Behind the pilot, a lounge bench ran fore and aft where the bombardier, navigator, and nose-turret gunner stayed during takeoffs, landings, and ground operations. Next aft, the bomb bay — or bays if you divide them into fore and aft — with a catwalk in the center running back to the rear fuselage compartment. Here, four crewmen operate: the radio operator (usually, in the area above the rear portion of the bomb bay, sometimes laughingly referred to as the command deck.) The radio operator usually mans one of the waist guns; the other waist gun is usually manned by the armorer. One man in the crew never gets much of a sun tan; he mans the ball turret, into which he fits himself and is lowered into the slipstream beneath the bomber, where he gets a 360-degree view of the Alps (or anywhere else he happens to look). One more soul rides the airplane, the tail-turret gunner, who looks steadily at the past. The combat crew, thus, consists of ten good men and true. Sometimes the bombardier is left at home; occasionally, two navigators ride, one to get into the nose turret to help in early location of the bombardier's aiming point; if enemy fighters lie in wait with drooling anticipation, an extra waist gunner provides a bit of reinforcement and leaves the radio operator free to stay on the radio. Rarely, a photographer comes aboard to get strike photos and have whatever other fun he can find. Combat crews, in the main, thought that happy-go-lucky trooper a Jonah.

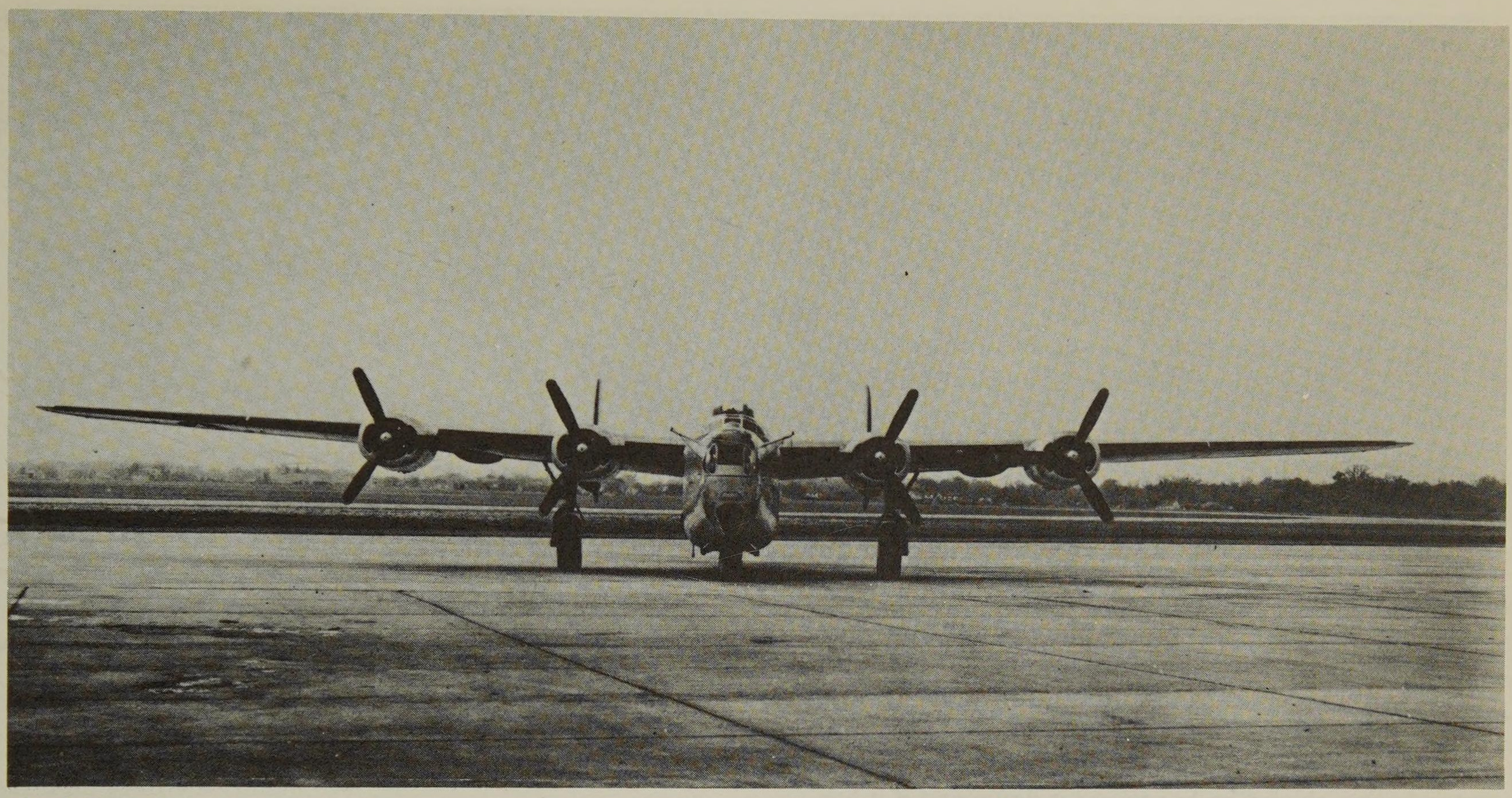
Those guns. After the D model, the nose was equipped with a turret, which featured twin .50 caliber guns. The top turret also sported twin fifties, as did the lower (ball) turret and the tail turret. The left and right waist guns were flexible fifty calibers, which meant, ironically, that they could shoot down their own airplane — usually by shooting off their own tail or firing into the wing, rupturing a fuel cell and causing much consternation. The four turrets were equipped with fire interrupters; these kept the turret gunners from shooting themselves down. Nothing, however, protected our friends around us from any overexcited gunner. Thus the pilot made a wise move to keep cool-handed gunners.

And so it was that this crew of about ten approached the airplane with flying in mind, normally approaching in a truck, all carrying their personal equipment consisting of parachute, usually chest-type but for some a back-type; heavy clothing, for high altitude guaranteed very cold weather (nearly always 40° below zero); leather helmet fitted with earphones; a throat microphone; a 45 automatic pistol — optional — with belt containing two extra clips of ammunition (twenty-one rounds all told); an oxygen mask; for some a machete or fire axe; and an escape kit containing money, a map, chocolate emergency rations and chewing gum to bribe children the world around. (I suggested the addition of nylon stockings, but the fools laughed me down.) This array of equipment meant a combat mission, not a local flight from Muroc.

This combat crew approached the airplane, boarded, and stowed their equipment in the order of required use; they inspected the aircraft equipment they were responsible for using on the mission. I stowed my equipment behind me in a certain order, my 45 third from the top, my lucky rag doll second from the top (insurance for getting back) and my heavy World War I machete on top so I could cut my way out of a burning airplane lying along the takeoff leg. Then all crewmen returned (usually) to a position near the nose of the plane and reported all in readiness. The pilot was usually briefed by the ground crew; he asked for each man's readiness for and understanding of the mission; then, perhaps with the copilot and flight engineer, he proceeded with his external inspection, beginning with a curious procedure: opening his pocket knife and stabbing at the nose-wheel tire. "Way out," an observer from another time might exclaim. "Not in the checklist," another might mutter. All would see the pilot was in dead earnest. Some would know that he was examining the depth of cuts in the tires, an important safety procedure. If he found, by prying, that cuts in the nose tire went deeper than six plies of fabric, he'd fold his knife and walk away from the dangerous bird; he'd do the same if the procedure exposed ten plies on a main-wheel tire. If the tires passed the test, he'd go in with the external inspection.

If the ground crew chief says he's already inspected everything, thank him, then do your inspection; if the flight engineer says he's already done the external and internal inspection, thank him and then do your inspection. You want to show confidence in these important men, but don't try to show it by accepting their inspection. Do it yourself. And do it the same way every time; follow the same routine.

Start at the right wingtip, the book says, so why not follow that same routine, inspiring confidence in those who accompany you; they expect you to start at the right wingtip. Note here that no one walks through the propellers or between the fuselage and a propeller. A careful walk-around takes perhaps five minutes, so plan for that time. Caution: Any ice or frost on the wing



The B-24 G, featuring 110 feet of wingspan and showing the sidewise-oval shape of the nacelles — eggs lying on their sides.

will cause significant loss of lift. Dangerous on any wing, ice or frost sharply degrades lift on the Davis Airfoil. To get to be an old pilot, get frost and snow off.

1. Check outer wing panel and running lights for dirt or breakage.

2. Look at right outboard de-icer boots to see that they are undamaged or uncracked.

3. Inspect No. 4 engine, the nose section for oil leaks or foreign matter wedged between cylinders. Check propeller for cracks, abrasions, and nicks in the leading edges of the blades. Sometimes a small, innocent-looking unevenness can seriously degrade thrust. Check anti-icer slinger ring for security.

4. Inspect de-icer boots between engines for cracks or damage.

5. No. 3 engine gets the same treatment as No. 4.

6. Look over right inboard de-icer boots for cracks or damage.

7. Check right pitot tube to see that cover is removed; otherwise the bombardier won't have an indication of airspeed. A kingdom could be lost for lack of a horseshoe nail. And even the navigator might be confused.

8. Check nose turret locked in forward position and free of damage.

9. Left pitot tube cover removed. This tube provides your very own indication of airspeed, without which chaos is come again. (Pitot heat can usually burn this cover off, if the flight lasts until then.)

10. Fire extinguisher can be checked for presence and proper stowage by opening small access door in fuselage on left side of nose. Re-close door securely.

11. You've led off by inspecting the nose-wheel tire. Now check out the whole nose-wheel assembly: tire for proper inflation, cuts, bruises, blisters, excessive wear, and slippage. (When the tire was mounted on the wheel, the tire shop painted a mark on the tire and on the rim. If this mark reveals *any* slippage, have it replaced.) Check oleo strut for 4¾-inch extension. Pressure gauge on shimmy-damper accumulator should read 250 lb./sq. in. Airplanes went more to the Houdaille-type damper, which has no accumulator. On this assembly, there is a needle plunger at top; check it for ⅜- to ⅝-inch extension. Check nose-gear down latch in the down position. Check nose-gear assembly hydraulic lines and fittings for leaks.

12. Check left inboard de-icer boots for cracks and damage.

13. Examine No. 2 engine as you did No. 4.

14. Check de-icer boots between engines for cracks and damage.

15. Examine No. 1 engine as you did No. 4.

16. Check left outboard de-icer boots for cracks and damage.

17. Check left outer-wing panels for condition, and check lights for breakage and dirt. Walk around wing tip to trailing edge of wing.

18. Eyeball the left aileron for fabric condition.

19. Check No. 1 nacelle for loose cowl-fasteners or damage.

20. Check No. 1 supercharger, examining the bucket wheel for alignment, free movement, warping of buckets, and for missing or cracked buckets. We down-to-earth folks sometimes call this bucket wheel a

turbine. (The jet-generation jocks, who sometimes are mystified at repeated references to manifold pressure, should look carefully at this turbine wheel and see whether or not their ideas reach across to the turbine wheel in a jet engine, which wheel translates straight to power. The supercharger turbo wheel compresses air to increase manifold pressure, which results in power in a manner hardly less direct.) Check the exhaust section for cracks and loose joints. Check the waste gate for full open position and free movement.

21. Check No. 2 nacelle for loose cowl-fasteners or damage.

22. Check No. 2 supercharger just as you checked No. 1.

23. Left main landing-gear check starts with the tires, which you check for proper inflation, cuts, bruises, slippage, and wear of tread, as well as tire-flange cracks. Oil leakage from the brake-flange area usually indicates a ruptured brake expander tube. Inspect hydraulic lines and fittings for security and leaks; check oleo strut for 3½-inch extension and for cleanliness. If that strut is not gleaming clean, ask the ground crew chief if he has wiped it down and if it has been habitually dirty or oily. Check that down latch is in position and is undamaged. Check point of suspension of landing gear for cracks or buckling. Any damage here may let you in for an exciting day.

24. Fuel-cell area of wing must show you secure inspection plates and must show you *no* leaks.

25. Look over left wing flaps for proper alignment with trailing edge of wing, in full up position, and free of skin damage, holes, or dents. Proceed aft along left side of the airplane if all is well to this point.

26. Check antenna for security.

27. Check ball turret in locked-up position.

28. Tailskid checked for full extension and for damage; check hydraulic fittings. On combat-configured airplanes, the tailskid is usually missing, having been broken by taxying over rough taxiways and having been subsequently removed.

29. Check left waist door wind deflector securely closed. Open, these deflectors create drag, increase fuel consumption. When you have a long mission, advise the gunners to keep deflectors closed except when using the guns for their designed purpose.

30. Examine left tail section, checking de-icer surfaces as in other places on the wings. Check stabilizer surfaces for loose rivets and buckling of plates. Check left fin, rudder, elevator, and trim tabs for alignment and condition of fabric.

31. Check tail turret for alignment and security.

32. Examine right tail section just as you did the left.

33. Check right waist door wind deflector securely closed.

34. Fire extinguisher. On way forward to right wing, check stowage of fire extinguisher in fuselage position just aft of rear bomb bay.

Complete your inspection for same items as on the left wing as follows:

35. Right wing flaps.
36. Right aileron. (Check trim tab for damage.)
37. No. 4 nacelle.
38. No. 4. supercharger.
39. No. 3 nacelle.
40. No. 3 supercharger.
41. Right main gear.
42. Fuel cell area.

Reject the airplane if you discover unsafe defects. List all defects on Form 1A. Also report all defects to your crew chief.

During this whole walk-around, you have not once walked through the propellors.

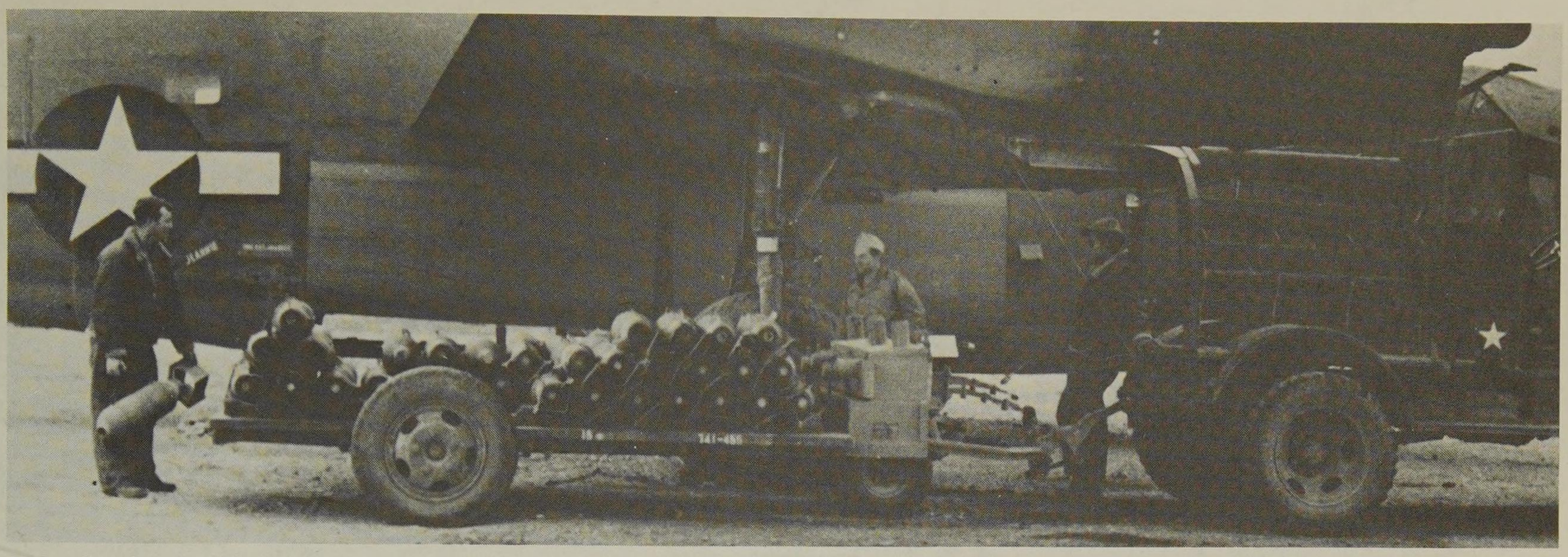
* * *

Returning to the front of the airplane, you are now ready to issue a genuine order to the crew: "Let's go," or "Saddle up," or something else that is as Napoleonically clear. Now ready to get in the airplane, walk aft along the left side, as does any good cavalryman, and bend to enter the bomb bay.

What to Inspect Inside:

Your crewmen are watching your every move; they want you to demand perfection and be perfect in every move because you are playing with *all* their money. You make every inspection precisely the same way every day, so go ahead and impress them with your precision, starting with a look at the bomb load as action one. Those vertical rows of olive-drab-painted bombs remind you grimly that you are about a serious matter. The intricate fuses wired and safetied to the nose and tail of each bomb remind you that it is not a simple business. Indeed the view reminds me that we are nearing the climax act for all this tireless preparation by so many people who have persevered to bring this operation to you. These people have a right to expect that you will bring your practiced professionalism to the delivery. Now walk aft along the catwalk.

1. Rear section of the fuselage: location and security of guns, ammunition, equipment, and cargo. For European combat missions boxes of chaff or window (the boxes of packages of metal foil cut to certain lengths to confuse the German gun-laying radar) will be stowed securely, ready for crewmen to dispense from the waist windows when you start the target run. This stuff looks like tinsel for Christmas trees, and is a sight to behold when you see it coming from hundreds of airplanes ahead of you on the bomb run.



Uploading bombs. Note the superman at left apparently manhandling a bomb.

2. Hydraulic reservoir (on right-hand side of bomb bay): make sure no leaks exist. Fluid should show on gauge to within ½-inch of red line. Check reservoir emergency suction valve in horizontal position.

3. Emergency hydraulic star valve: check in the closed position and safety wired.

Now step up into the flight deck, only observing that the auxiliary hydraulic pump in the forward bomb bay on the bulkhead to the right of the door is in the Off position.

4. Fuel selector valves: two located on each side of bulkhead beside door leading to the bomb bay (valve locations vary with some groups of airplanes). Check to see that each of the four valves is set in tank-to-engine position, No. 4 tank to No. 4 engine and so on, to insure that each engine is receiving fuel from its main fuel cells only. Be sure no tank is set to include crossfeed; the dangers are explained in the tech orders under the discussion of fuel management — something else you must study.

5. Fuel sight gauges (on right side bulkhead looking back to the bomb bay): be cautious reading these gauges, since accuracy is dependent upon the centering of the inclinometer located just to the right of the gauges. The best procedure is for the flight engineer to see that the tanks are full; then you can check the gauges. If you fly the same airplane all the time, you'll become skilled at interpreting these babies.

6. Flight deck: see that no loose junk is around, that necessary equipment is properly secured, that unnecessary equipment gets out of the airplane, and that the bird is *clean*. A dirty bird angers me; a clean airplane inspires confidence in me. The same simple rule of cleanliness works all through the Air Force: dirty hangar, sloppy maintenance; clean hangar, good maintenance. Good men with pride win wars. Note. The sermon on cleanliness is free.

7. Crew: before you sit down in that pilot's seat, satisfy yourself that all your good men are aboard with parachute and oxygen mask, with proper clothes for the mission. Check that first-aid kits are in their proper places, that all stations have enough oxygen for the mission. Assure yourself that all aboard know the emergency signals for bailout and ditching and that they know these procedures. Oh. Is the loading list you left at operations complete?

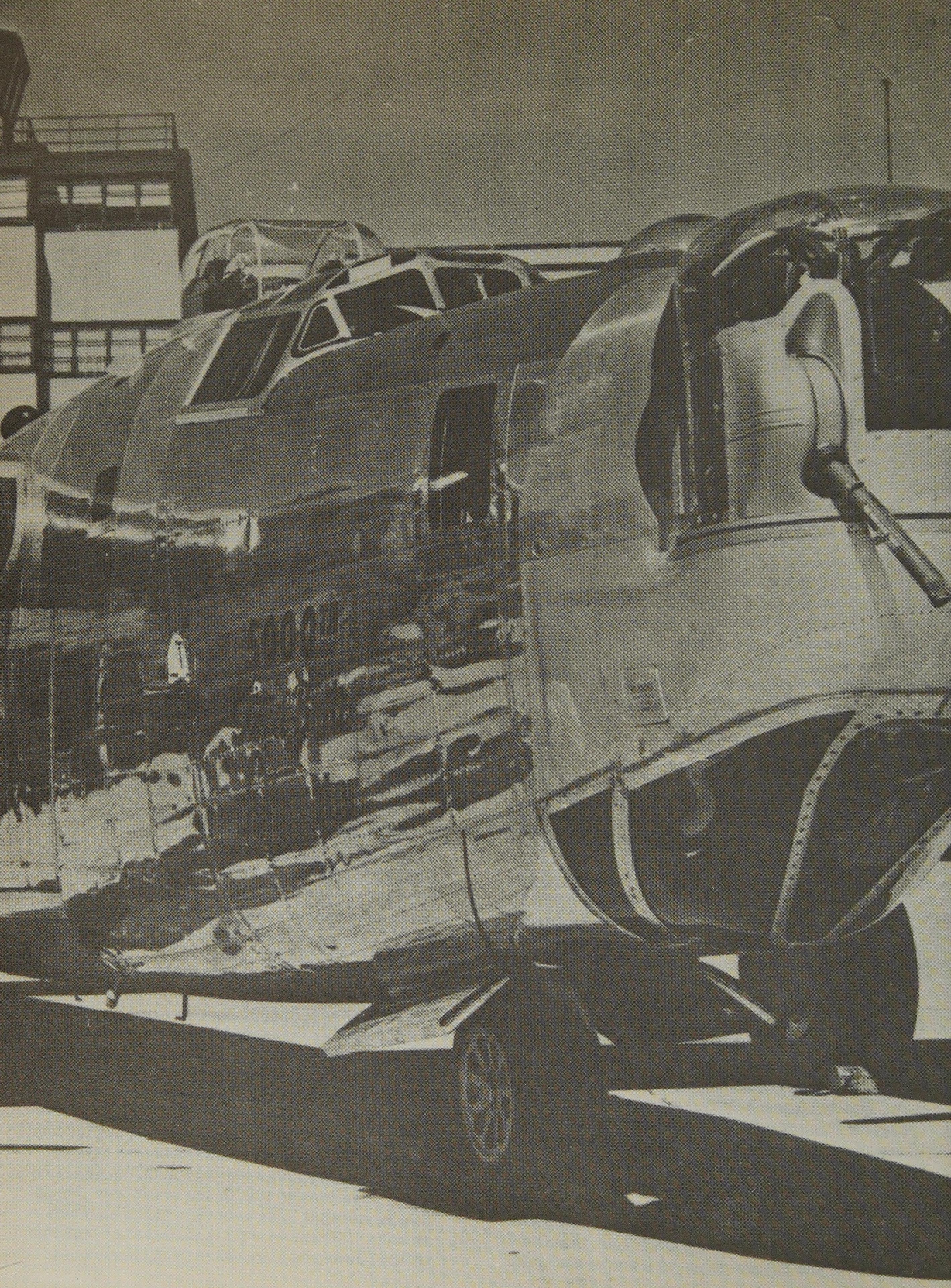
8. Maps and navigational aids: ask the navigator if he has all the maps and charts needed. Check to be sure that copies of instrument procedures, radio facility charts, and radio aids to navigation are aboard.

9. Form 1A: study all writeups and make your decision about the airworthiness of the airplane. Look at Form F, Weight and Balance — no unusual loads aboard on this flight.

10. Engines pulled through: if you haven't seen this done before you got in the bird, see it done now, and properly, six blades, with men clear of the plane of rotation of the propellers, after you have checked that the switches are Off.

11. Seating: get in your seat, fasten safety belt, adjust seat for fore and aft position, up and down, and tilt; and set rudder pedals to allow full rudder and brake control. Set the position of the rudder pedals by pushing the pedal adjustment lever away from the pedal with your toe and moving the pedal fore or aft. Be sure the catch relocks properly — this carefulness can mean the whole ball game.

12. Unlocking controls: have the copilot unlock the controls and securely stow the strap overhead. A loose strap is sure to get in the wrong place at the worst time. Copilot checks the locking lever in full down position to make sure the lock is released. Now, good and faithful pilot, all this preliminary examination has brought you to a landmark. All your studies, all your dry-run procedures, your blindfold checks, your operational preparations, your coordination with your crew, have brought you to this single gate through which you must now pass: The checklist. Think a moment. 2700 gallons of gas in the tanks? All crewmen aboard? Emergency equipment all in place?



2
Checklist, Semper FI

Sitting up there in the left seat of a Liberator gives one a lordly feeling of being in charge of things, but one won't be in charge long if one is careless, ever, about managing this demanding airplane. One doesn't ever fail to use one's checklist. So take this five-by-eight card in hand and call out in good command voice.

1. Checklist.
2. Copilot picks up his checklist.
3. Copilot calls out each checklist item in sequence. Here, as Napoleon said, "Be clear."
4. Pilot, copilot, or engineer takes the action demanded by the item and calls back the answer clearly and professionally.
5. Complete each item before going on to the next.

Before starting engines:

1. *Form 1A?*
   Pilot replies, "Form 1A checked."
2. *Loading?*
   Pilot replies, "Loading checked."
3. *Wheel chocks?*
   Each pilot looks on his side. Chock should be flush against the tire but 2 to 6 inches in front of it. Parking brakes will, normally, hold the airplane. If chock is properly placed, the pilot calls, "Wheel chock in place left"; the copilot calls, "Wheel chock in place right."
4. *Pitot covers?*
   Each pilot looks at the pitot head on his side; pilot calls, if the cover has been removed, "Removed left." Similarly, the copilot reports, "Removed right."
5. *Gas-tank caps?*
   If a gas-tank cap is not properly seated, gas may be siphoned out by the suction on top of the wing, rapidly emptying the tank. Deadly danger from fuel going back into a hot exhaust or into the bomb bay. To avoid such a contingency, the flight engineer, when he tops the tanks, seats the caps and safety-wires them. At this call he reports, "Gas caps checked and safetied."
6. *Flight controls?*
   Pilot and engineer accomplish this check, pilot moving each control to extreme position and calling each set to the engineer, who looks out the top hatch and reports each position observed. For instance, the pilot moves the wheel full back and calls, "Elevators?" The engineer replies, "Elevators up." The pilot moves the wheel full forward and the engineer calls, "Elevators down." The check continues. "Rudders?" — "Rudders right," "Rudders left," "Rudders neutral." "Ailerons?" — "Right aileron down, left aileron up." "Left aileron down, right aileron up."
7. *Fuel tank valves and amount?*
   Engineer replies, "Checked," reporting the number of gallons of gas, normally 2700, and gallons of oil aboard.
8. *Generators?*
   Copilot and engineer look back to check generator switches in Off position. Generators are kept off until just before takeoff to prevent drain of battery current back to generator in case of faulty reverse current relay, and because generators will not charge unless rpm is 1700 or more. Engineer reports, "Generators Off."
9. *Carburetor air filters?*
   Unless dust and blowing sand exist, carburetor air filters are always kept closed. The engineer sets them as directed for local conditions, reporting, "Carburetor filters as required."
10. *Main line and battery selectors?*
    Copilot turns on these switches down on his right side panel. (The main line is called the "crash bar" because it gets thrown to the Off position in case of that dreadful thing, a crash.) The copilot checks each of the two battery switches separately by referring to the voltmeter reading to determine the battery condition. If a battery cart is used to start engines, the copilot turns on the main-line switch but leaves the battery selectors off. This directs current from the cart through the main-line bus and prevents drain of the plane's batteries. The copilot reports, "Main line and battery selectors On."
11. *Auxiliary power unit and hydraulic pump?*
    The engineer starts the auxiliary power unit and turns on the auxiliary hydraulic pump. The pump cuts in to charge the accumulators when the pressure drops below 975 lbs. and cuts out at 1180 lbs. When the No. 3 engine is operating, the engine-driven pump charges the accumulators through the unloading valve when pressure drops below 850 lbs. and cuts out at 1050 lbs. Engineer reports, "Auxiliary power unit and hydraulic pump on."

12. *Brake pressure and parking brake?*

Applying the brakes, the pilot checks the inboard and outboard brake-pressure gauges at 975 to 1180 lbs., then sets the parking brakes, and calls, "Pressure checked and parking brake on." To set the parking brake, hold the brake pedals down, raise the parking-brake handle and then release the brake pedals. Never force the handle either up or down or you'll likely snap the locking pin.

13. *Gyros?*

Pilot uncages the directional gyro and the flight indicator. Then, when the engine that supplies suction is started (No. 1 or No. 2), the speed with which the flight indicator rights itself indicates its reliability — except Jack and Heintz indicators, which must be uncaged and manually righted after engines are started. Pilot reports, "Gyros uncaged."

14. *Automatic pilot?*

Pilot checks all switches on autopilot Off. If one attempts to take off with this unit connected, he needs to be very strong. Pilot calls, "Automatic pilot off."

15. *Superchargers?*

Pilot checks all superchargers in Off position (hydraulic or oil-line controls). Hydraulic controls had to be left in Off position when the engines were shut down at the end of the last flight so that waste gates are open. If waste gates are closed when you start the engines, the exhaust system or the turbo may be damaged by the excessive exhaust pressure. With electronic turbo control — such an improvement — set the dial at zero. Pilot calls, "Superchargers off."

16. *Propellers?*

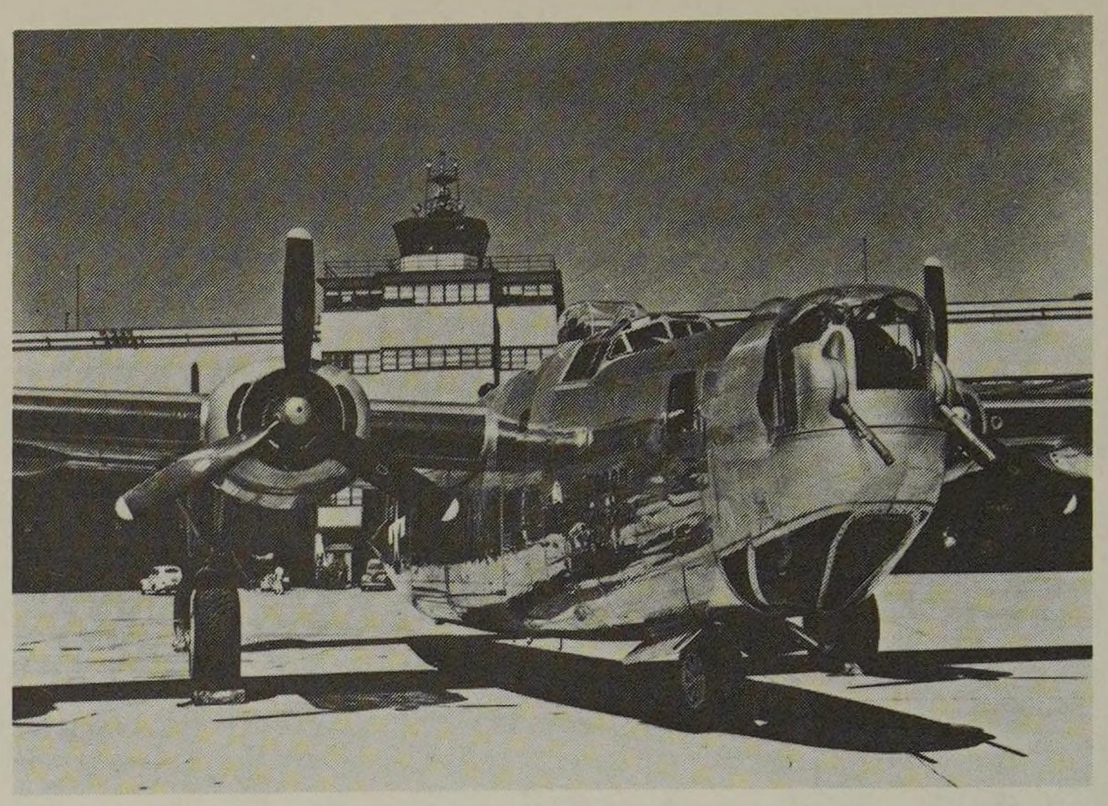
Copilot holds propeller toggle switches forward to *increase rpm*. If governor limit lights come on, propeller governors are set for full high rpm. The copilot reports, "Props in high rpm." Note: be sure to move toggle switches forward, as governor limit lights will also come on when toggles are moved back; this would set the governor for full low rpm.

17. *AC power switch?*

Copilot moves this switch to No. 2 inverter and checks it by switching on one booster pump and noting the rise in fuel pressure on the corresponding fuel pressure gauge. He then turns off the booster pump, moves the AC switch to neutral, waits five seconds, switches to the No. 1 inverter and again uses the booster-pump check. Copilot calls, "AC power on and checked." Normal procedure says to use the No. 1 inverter and reserve the No. 2 for an emergency. Don't switch back and forth between the two inverters. Wait at least five seconds in neutral position when switching from one inverter to another to avoid arcing the points and blowing a fuse.

18. *Intercoolers?*

Copilot checks intercooler shutters in open position, which is normal, and reports, "Intercoolers open." Don't close these shutters here as they may



Number three nacelle showing like a lazy egg. The airplane gleams like the armor of Achilles.

cause overheating and detonation on takeoff. Check the proper operation of shutters by listening to each motor as you move switches to closed and back to open positions.

19. *Pitot heater?*

Copilot flicks switch on and off while looking back at the voltmeter for a flicker indicating current drain. The only accurate check is for the engineer to feel the pitot-tube heat during preflight. Be careful not to do this yourself; you might burn your hand. The engineer reports, "Pitot heaters checked."

20. *Cowl flaps?*

Copilot opens cowl flaps and checks them on the right. Pilot checks them on the left. Pilot calls, "Cowl flaps open left." Copilot calls, "Cowl flaps open right." Open position for starting helps keep the engine cool. Tech orders, always cautioning about fire, say open cowl flaps help the fire guard put out fires. Maybe so. Undoubtedly so. And the mentors want us to be highly conscious of the dangers of fires. But fires in routine operations are not too common — maybe because we were careful to heed warnings.

Caution: never close cowl flaps to hurry warm-up; you don't want to damage the ignition harness from excessive heating.

21. *Mixture controls?*

Copilot checks mixture-control levers forward in "idle cut-off." Otherwise the blower section will be flooded when the booster pumps are turned on, creating — guess what? — a *fire hazard*. Copilot calls, "Mixtures in idle cut-off."

22. *Wing flaps?*

Copilot checks flap-control handle in neutral position and looks at the flap-indicator gauge to be sure it shows that the flaps are up. Copilot calls, "Wing flaps up."

23. *Wing de-icers, propeller and carburetor anti-icers?*

Copilot checks each in Off position. Even partial inflation of the wing de-icer boots reduces lift and

increases stalling speed. When on, propeller anti-icers will pump fluid on the ground, and carburetor anti-icers will pump fluid into the carburetors, enriching the mixture. Note: if exhaust heat anti-icing is installed, the cabin heat or anti-icing switches may be on if desired. Copilot calls, "All de-icers and anti-icers off."

Now the intrepid pilot has completed the before-starting checklist and is ready to make some noise.

Starting:

Follow procedures precisely to develop the best starting techniques. (The first time I went through the procedure I got a surprise — the engine started.) The pilot must be sure the copilot and engineer understand the precautions for starting engines. One man must be posted as fire guard just outboard of the engine being started and another man in view of people in the cockpit to relay signals to the fire guard.

Start engines:

1. Copilot calls "Clear." Fire guard posted. Copilot and pilot stick their heads out the window to check personnel and shout, "Clear." Copilot checks that a fire guard is posted and holds up three fingers to indicate that he will start No.3 engine first. Copilot reports, "All clear and guard posted." Start engines in the sequence 3, 4, 2, 1, to keep guard from running through an outboard prop in case of fire and because the engine-driven hydraulic pump operates off No. 3 engine. But, when engines are energized externally, start in sequence 1, 2, 3, 4 to keep the ground crewman safely clear of the propellers.

2. *Ignition switches?*

Copilot turns on the ignition switches for all four engines and calls, "Ignition switches all on."

3. *Throttles?*

Pilot moves all throttles to cracked position, which means about one-third open. This prevents excessive backfiring and overspeeding of engines on starting. Pilot calls, "Throttles cracked."

4. *Booster pump?*

Copilot turns the booster pump on for the engine to be started to supply fuel pressure for priming and notes fuel pressure, normally about 8 lbs. Copilot reports, "Booster pump on."

Priming: engine may be primed when fuel pressure is above 4 lbs. Copilot primes by pressing the primer switch for one second and then releasing it. The number of one-second shots will normally be not less than three nor more than six, depending on the temperature of the engine and the outside air. Priming drives the fuel into the engine intake in spurts. Copilot primes while he is energizing.

Two types of starters: energizing time varies with type of starter. The old type requires thirty seconds, time enough for the bad guys to catch up. Switch is moved up to Start for energizing and down to Mesh. Energizing stops when the switch is on Mesh. In the new-type starter there are separate switches for energizing and meshing. Move first switch up to Accel to energize for twelve seconds and keep it there while you move the second switch to Mesh. Thus the energizing continues during the cranking or meshing. Some nameplates are marked Crank instead of Mesh.

5. *Start engines, copilot calls.*

a. While priming with one hand, copilot energizes starter with the other hand for the required number of seconds. (As you may note, this coordination of different time periods on different switches proves that copilots must be able to walk and chew gum at the same time.)

b. Copilot meshes starter and holds it until the engine is definitely started because the booster coil or induction vibrator is hooked up to the meshing switch. If the engine doesn't start immediately, use more priming. (But remember, you aren't starting a B-25, some of whose pilots leave the throttle fully closed until they get the engine running smoothly on prime alone. They're usually those gunshy about blowing a stack.)

c. As soon as the engine fires, the pilot brings the mixture-control lever back to Auto-rich and leaves it there.

d. Copilot turns the booster pump off.

e. Copilot watches the oil-pressure gauge start coming up and calls, "Oil pressure coming up." If oil pressure does not rise within thirty seconds, copilot puts the mixture control in Idle cut-off and stops the engine. If the pilot has been reading his *Esquire*, he'll likely look up and inquire about the progress of events. But if No. 3 is running nicely, the copilot proudly reports, "No. 3 started."

Successive engines are started in the same manner.

Warm-up: throughout the warm-up and other ground operations, when not taxying, idle the engines at 1000 rpm. Warm-up continues until the oil-temperature indicators for all engines reach 40°C minimum, and until cylinder-head temperatures reach 120°C.

6. *Flight indicator?*

When No. 2 and No. 1 engine (whichever is supplying the vacuum) is started, the pilot checks the speed and precision with which the flight indicator rights itself. If righting action is sluggish, the instrument needs repair. Remember, if you have a Jack and Heintz Model JH 6500, it must be left caged until the engine has been running for five minutes to allow the rotor to attain full speed. Then uncage and watch to see that it doesn't spill.

If an engine stops: if an engine stops, immediately put the mixture control in Idle Cut-off and repeat entire starting procedure. If the propeller starts turning when you re-energize, release the energizing switch and *cut the ignition switch Off*. Then have a crewman rock the propeller to disengage the starter dogs. Don't forget the necessary safety procedures.

If an engine is flooded: if an engine becomes flooded put the mixture control in Idle Cut-off and open throttle fully until excess gasoline is cleared out and engine begins to fire. Then immediately move throttle to 1/3 open and move the mixture control to Auto-rich.

If an engine won't mesh: If an engine won't mesh or crank, and you want manual meshing, notify the man in front of the airplane by raising a clenched fist and pulled sharply downward. He will use the same signal to notify the fire guard, who will then pull the manual meshing handle. The meshing switch on the copilot's panel should be used when meshing manually, even though it is apparently not working, since it also completes the circuit to the booster coil or induction vibrator.

When all engines are started and warmed up, begin the before-taxying check.

Before taxying:

Make a careful check before you move the airplane to make sure your engines, instruments, and radio are operating properly. All the readings given below are maximum and minimum limits for 1000 rpm.

1. *All instruments?* Directional gyro: pilot pushes caging knob to caged position, spins, and quickly uncages. Indicator should stop moving when uncaged. If it continues to spin, gyro requires repair. Try it both ways, left and right. Pilot calls, "Directional gyro checked."

Copilot checks:

a. Manifold pressure. Check for steady indication. Erratic reading indicates defective instrument.

b. Tachometer. Check for steady indication at 1000 rpm.

c. Fuel pressure. Check reading from 16 to 18 lbs.

d. Oil pressure. Check reading from 45 to 100 lbs. Low reading may indicate oil shortage or pump failure; it could indicate instrument failure, but usually does not.

e. Oil temperature. Limits are 40° to 100°C. Desired range is 60° to 75°C.

f. Cylinder-head temperature. Limits are 120° to 232°C for ground operation. Do not operate above 1000 rpm until temperature is 150°C or more.

g. Carburetor-air temperature. If humidity is high, ice may form during ground operation if carburetor-air temperature is below 15°C. Best operating temperatures are between 15° and 35°C. Above 35°C, detonation is likely.

h. Hydraulic brake accumulator pressure. Check inboard and outboard gauges for readings between 975 and 1150 lbs. *Don't start taxying if either gauge is below 950 lbs.*

Separately check the hydraulic system by pushing the gear handle down; if it kicks right back up to neutral, the free-flow system is operating properly.

i. Gear warning light. Should be lighted. If not, bulb may be burned out, fuse may be blown, gear may be unlocked, or microswitches may be out of order.

j. Free-air temperature. Check against temperature you got at weather briefing. Correct temperature will help in anticipating icing conditions.

k. Compass. See that deviation card is in place and up-to-date.

Now copilot reports, "All instruments checked."

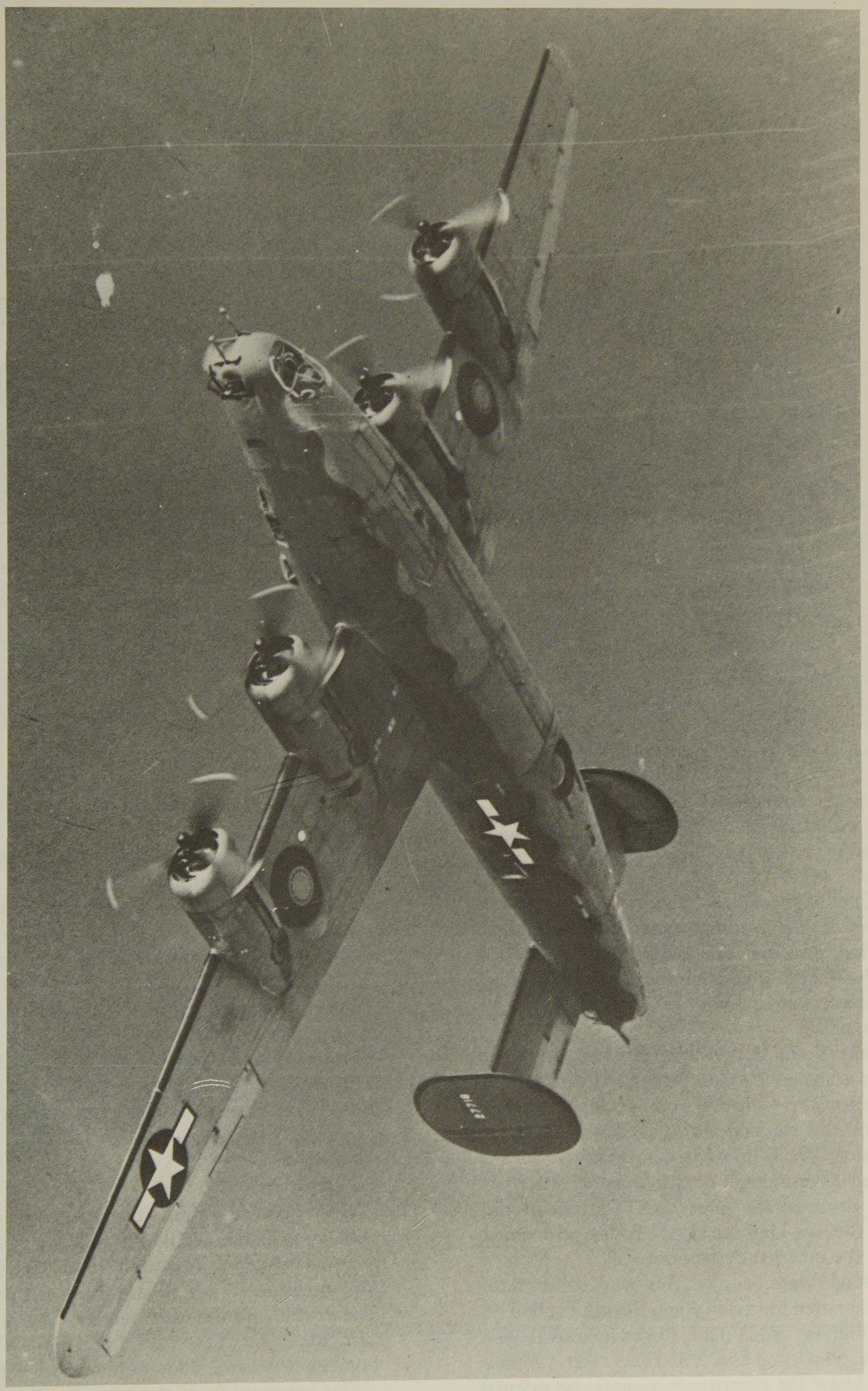
2. *Vacuum?* Engineer calls out No. 1 or No. 2 engine (whichever is supplying the vacuum). Pilot checks his gauge and, if gauge registers between 3.75 and 4.25, calls, "Checked." Engineer turns the vacuum selector valve to the other engine and the procedure is repeated. Pilot calls, "Vacuum checked on Nos. 1 and 2."

3. *Radio, altimeter, time.* Copilot calls the tower for radio check, altimeter setting, and correct time.

a. Radio check has three elements: (1) Frequency (Low-frequency radios of the early forties needed setting right on listed tower frequencies, or one or more kilocycles low or high, adjusting for strongest reception and clearest readability). (2) Readability — R — 1 to 5 for clarity. (3) Signal strength — S — 1 to 5. The desired check is "On frequency, R5, S5." And thus we can reach out and touch somebody. Copilot reports, "Radio checked."

b. Altimeter setting. Pilot sets altimeter at barometric pressure and notes difference between altimeter reading and actual field altitude. Maximum error permissible is 50 to 75 feet. Pilot then resets altimeter to actual field altitude and notes error in barometric reading. Thus, if the tower gives a reading of 29.20 but altimeter reads 29.25 when set at correct field elevation, .05 should be added to any barometric reading obtained during the flight. As a rule-of-thumb guide only, .01 difference in barometric reading equals 10 feet altitude. Pilot calls, "Altimeter set."

(Brief anecdote, skip if weary: in my combat squadron in Italy in 1944, the instrument man thought 29.29 inches of mercury was the standard barometric pressure; we know it is 29.92 inches. We used a setting of 29.92 for bombing, thus grinding in a pretty good error; but we rewarded the bombardiers who got the best strikes with promotions and group leads, thus equaling the irony of the forest animals that chose the turtle as their fastest messenger. The animals burned in the forest fire, but we won the war, or was it other lead



And it flies.

A B-24 formation in combat dress and headed for battle.

crews from other squadrons? Compensating errors, bombardiers would say.)

Anyway, after setting the altimeter, the pilot would say, "Altimeter set."

c. Time. Copilot checks cockpit clock against tower report. In combat, the group navigator gave us a time hack at briefing; thus our wristwatches governed.

4. *Alarm bell?* Pilot gives the normal abandon-ship signal and each crewman replies by interphone that he has heard the bell.

(Another anecdote: Bombardier Burke, a combat returnee, was assigned to a Southwestern training base as an instructor for Chinese bombardier students, where he took the students out daily for a five-hour bombing session. The Chinese had no English so were carefully briefed beforehand by a translator. After the bombs were dropped the pilot had to grind off the remainder of the five-hour missions. Today he decided to check out the emergency bail-out bell.

Social demands were heavy at this base, so our hero had, as usual, settled for a nap when the pilot called on interphone to advise of his plan. Burke acknowledged drowsily; the pilot rang the bell. The alert Chinese student well knew the emergency signals; he opened the emergency door, grabbed his drowsy instructor and, despite frantic objections, thrust him out of the plane, following himself. They pulled their ripcords and floated safely to the desert floor, having thereafter a long, hot walk, during which they had ample time to consider the cause of the communication problem.)

5. *Wheel chocks?* Pilot and copilot look out the windows, signal ground crewmen to remove the chocks. When chocks are removed, pilot calls, "Wheel chocks removed left." Copilot calls, "Wheel chocks removed right."

Note: if the airplane is equipped with an eletronic turbo control, always keep the dial set at zero unless turbo boost is needed to prevent carburetor ice.

Taxying:

Now you are about to provide the instructor pilot with some high comedy, but he'll get exasperated after a wearying time. The really bad part is that clumsy taxying imposes severe strains on the nose gear, main gear, tires, and the commander, who watches from a safe distance. Your first taxying of a four-engine bomber can make you yearn to be a fighter pilot.

Get approval from the tower and you are ready to move the bird.

RESTRICTED

FOR OFFICIAL USE ONLY

AN 01-5EE-1

PILOT'S FLIGHT OPERATING INSTRUCTIONS

FOR

ARMY MODELS
B-24G, H and J

NAVY MODEL
PB4Y-1

BRITISH MODEL
LIBERATOR
GRVI and BVI
AIRPLANES

This publication replaces AN 01-5EE-1 dated 5 January 1944.

This reissue replaces all pages of the above mentioned publication. Place this reissue in the existing pressed board binder.

This publication contains specific instructions for pilots and should be available for Transition Flying Training as contemplated in AAF Reg. 50-16.

This publication shall not be carried in aircraft on combat missions or when there is a reasonable chance of its falling into the hands of the enemy.

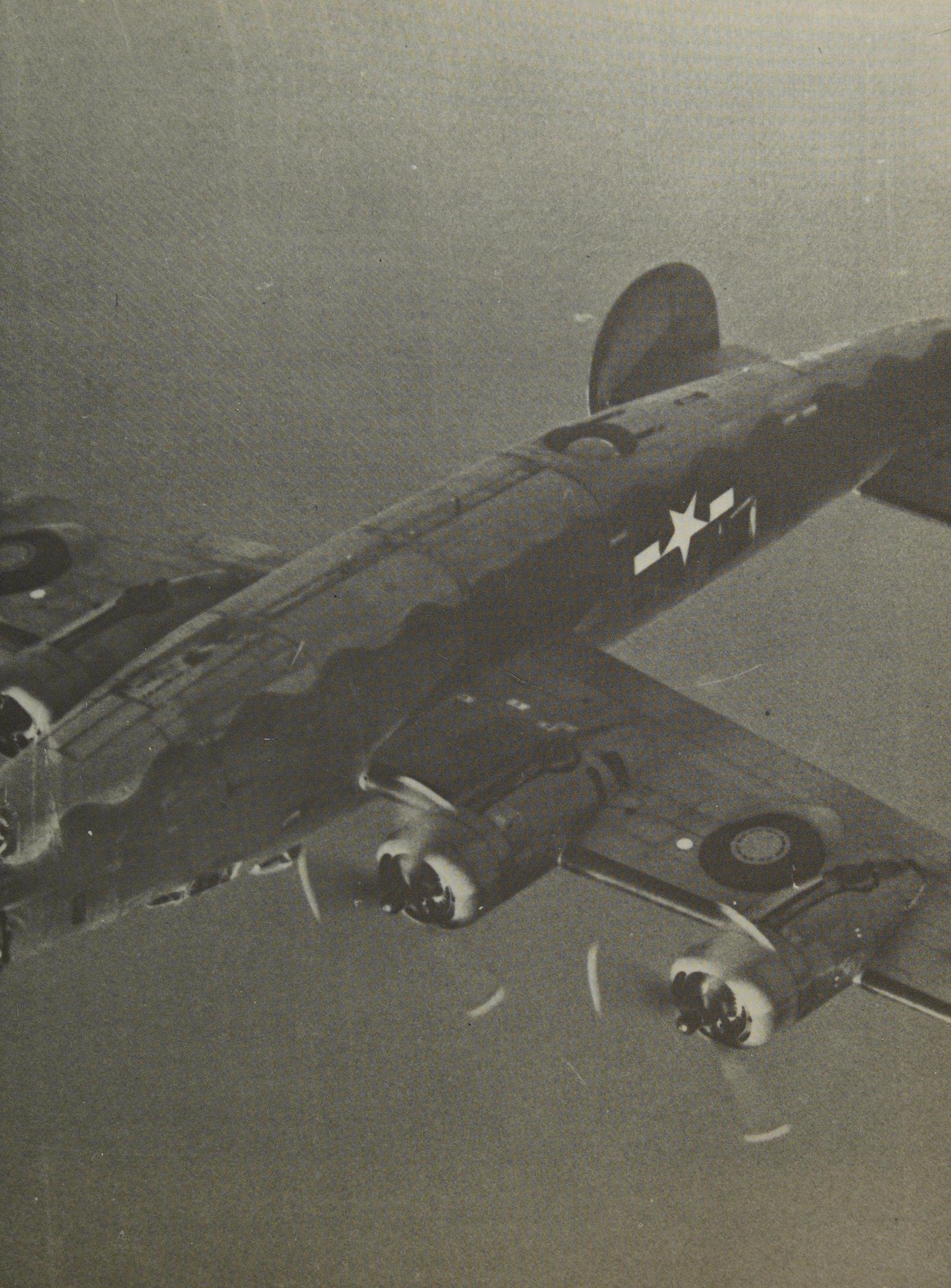
Published under joint authority of the Commanding General, Army Air Forces, the Chief of the Bureau of Aeronautics, and the Air Council of the United Kingdom.

NOTICE: This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, 50 U. S. C., 31 and 32, as amended. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

RESTRICTED

Keller-Crescent Co., Evansville, Ind.—12-1-~~44~~—16,600

30 NOVEMBER 1944



3
Taxying and Takeoff

Since this part of the book is a correspondence course in flying the Liberator, some discussion of techniques is in order.

Position of feet: set your heels on the rudder pedals with your toes well up above the brake pedals. *Always keep your toes off the brake pedals when not using the brakes*. Only slight pressure will build up tremendous friction and heat. Save your brakes for emergencies when you need them.

Use of rudder: when learning to taxi, hold rudders neutral as rudder control is ineffective except at excessive speeds. Also, when holding full rudder, it is difficult to use the brakes effectively. Ask your copilot to help hold rudders neutral.

Safety observer: post the engineer as observer with his head out the top escape hatch to watch for obstructions and call signals, "Clear left," and, "Clear right." On the ground, the wingtips are not visible from the cockpit (they lift and become visible once airborne and the wings are lifting the load); consequently, you'll need a ground crewman walking at each wingtip when taxying in congested areas.

Be sure the nose wheel is straight. If turned more than 30 degrees, it should be straightened with a bar. If you start taxying with the nose wheel turned, allow the airplane to roll a short distance in the direction it is turned, and it will tend to straighten itself out. *Don't force the airplane straight ahead with power and brakes against a cocked nose wheel.*

To start moving: reduce power to idling; fully depress brake pedals and release the parking brake handle. Then follow it up by hand to make sure it is released. Advance all throttles slowly and evenly until the airplane starts to roll. Don't use excessive power — something experience must teach — and as soon as the airplane is in motion, reduce the power.

Use of throttles: all four throttles are spring-loaded, tending to hold higher rpm than that needed for idling, making it necessary to hold back pressure on the throttles to keep from taxying too fast. Throttles tend to creep forward unevenly at low power settings. Frequently check the tachometers to maintain uniform power settings on all engines. Then you won't have to brake against an overspeeding outboard to maintain directional control.

An expert at taxying the B-24 can control it with throttles alone and without brakes, the tech order reads. So work to become an expert; then you'll learn that it is not so under all conditions. But when you become expert, you will never mind, as the old Air Corps ballad says. You can usually maintain speed equal to a brisk walk with 700 to 800 rpm on hard surfaces. If the airplane is easing to the right, add power to the right outboard engine; but don't hold this power until the airplane swings back into line or it will swing past the desired point. Then you will have to add power to the left outboard — and so on, chasing the desired line of taxying, building up excessive speed and necessitating the use of brakes. If the instructor can gain control of his laughter, maybe he'll take the throttles and demonstrate proper technique. But if this intervention persists, he won't check you out.

The way to hold the throttles is palm down with the throttle knobs against the padded part of the palm, third finger-joints on top of the throttles and fingers curled over them. In this way you can control any throttle separately.

Turns: a big airplane, the B-24 needs a lot of space for turns. You should visualize the radius needed. The main gear at the inside of the turn is the moving turning point, and it is far aft of your position in the pilot's seat. Your initial tendency is to turn too soon because you feel yourself going past the turning point.

On a left turn the pilot should watch the left wheel; on a right turn the copilot should watch the right wheel; that is, each should watch the inside wheel to see that it is turning at the correct place and that it keeps rolling, not pivoting.

Note: you are controlling twenty to thirty tons of airplane, and there is a delay between the application of power and the reaction of the airplane. Think and act ahead of the airplane and anticipate its delayed reaction. In this alert way you can keep Hitler, Mussolini, and Tojo sad. (Remember the placards all around the base during World War II showing the aforementioned dudes cheering when you put your head up your rear and locked it to do thoughtless things.)

How to turn: if the airplane is rolling at proper taxying speed, no brakes are necessary to start the turn. Slowly apply power to the outside engine to start

the turn and remove power as soon as the airplane responds. Don't use excessive power. It is better to use too little throttle and then add more than to start too fast a turn and have to correct with the opposite outboard engine. This produces a seesawing action. If you build up too much speed or too much turning action, throttle back, get control with the brake and start over. Don't take a chance on dropping your airplane in a mudhole.

Don't pivot: the most common error in turning is to pivot the airplane. Don't brake the inside wheel to a stop and then pivot around it. This grinds the tire against the ground or cement, twisting the ply and weakening the tire. This torque against the gear and strut can also cause more trouble than you need to explain.

Before starting to turn, when stopped, be sure to pick up forward motion and then to keep the inside wheel rolling steadily throughout the turn. Do not make short-radius turns, for the nose wheel should never be turned more than 30 degrees from the center line.

Bank-and-turn indicator: during turns while taxying, make sure that the turn indicator is functioning properly, returns to neutral when the turn is completed, and is not sluggish.

Use of brakes: brakes should be applied with a smooth, steady buildup of toe pressure. Sudden application of the brakes slams the nose down, puts heavy strain on the nose and main-gear assemblies, and may damage the brake-expander tubes.

Require your copilot to check the accumulator pressure every thirty seconds and report "Pressure OK" or "Pressure below 800 pounds." If the pressure is below 800 pounds, stop the airplane in its tracks and don't move it until the trouble is corrected. Always taxi with the auxiliary hydraulic pump On. It should cut in when pressure gets below 975 lbs. and should maintain pressure between 975 and 1180 lbs.

Stopping: always hold the airplane straight ahead when stopping, so the nose wheel will be in the straight-ahead position. Apply sufficient brake pressure evenly to both brakes to slow the airplane. This will vary with the speed of the airplane and the distance available for stopping. As the airplane slows, release brake pressure gradually. If you hold a constant pressure, the nose will snub down sharply, causing a jerky stop. With proper use of the brakes, you can bring the airplane to a full stop with no snubbing or ducking of the nose. Save the tremendous reserve power of your brakes for emergencies. That nose gear is right under you; if you brake too hard you'll put it in a place where you didn't want it.

It takes a lot of room: the B-24 has 110 feet of wing span, as much as three P-40's taxying wingtip to wingtip. Give yourself room.

Note: taxi with all four engines running. If an engine is feathered, the opposite engine may be cut for easier taxying, but in no other case should engines be cut.

With these basic rules for taxying, go on out and make your mistakes in as minor a way as possible, learning and getting the feel for the chore. These acquired skills will put you in charge and make life easier.

When you reach the run-up area, turn the airplane into the wind as far as practicable, still leaving you in position to watch traffic. Stop the airplane. Set the brakes in the clever fashion you've just mastered. If it has been a hot day, you'll mop your brow as you deserve.

* * *

Engine run-up before takeoff:

Now the tech order tells you that every airplane has its own pecularities and that this run-up is your chance to get better acquainted with the machine, feel it out and judge its condition.

The big B-24 blows a big wind, so don't run up in line with someone directly behind you. Get properly in the proper run-up area, stopping with the nose wheel straight ahead. Fully depress the brake pedals, lift the parking brake handle to the locked position without forcing it, and release the brake pedals. This should lock the parking brakes. Set all four throttles at 1000 rpm. Now follow the checklist.

Crew position for takeoff and landing: be sure your crewmen know their position for takeoff. No one should be in the nose compartment because of the danger of injury if the nosewheel should collapse. No one should be aft of the waist guns because this materially alters the center of gravity and causes tail heaviness. No one should be in the bomb bay.

Usual positions: Pilot, copilot, engineer, navigator, bombardier, and nose gunner take position on the flight deck (extra nose navigator if assigned is also here, as is the radio operator if his position is on the flight deck; later airplanes had the radio operator on the command deck, aft the bomb bay). Gunners — waist gunners, ball-turret gunner, tail-turret gunner — and, if one is aboard, the photographer, take position just aft of the bulkhead between the aft compartment and the bomb bay.

Crew should not shift from their positions until the airplane is clear of the field, the landing gear is up, and the wing flags are up. At least one man in the rear compartment must be on interphone during taxying, takeoffs, and landings.

Before-takeoff check: (Items with asterisk must be checked for all takeoffs, such as touch and go.)

*1. *Trim Tabs?*

Pilot sets tabs as desired (normally, 2 to 3 degrees right rudder, elevators 1 to 2 degrees up, and ailerons at 0 degrees. The right rudder trim corrects for torque

during takeoff). Pilot answers, "Trimmed for takeoff."

*2. *Mixtures?*

Copilot checks to see that all are in Auto-rich. *Danger:* don't take off in Auto-lean because of the danger of detonation or engine failure. Copilot reports, "Mixtures in auto-rich."

3. *Exercise propellers, turbo-superchargers and flaps.*

Pilot sets all throttles at 1500 rpm. Then copilot changes propeller governors from full-high to full-low rpm and back to full-high rpm, holding the gang switches for all governors until the propellers change all the way (all governor limit lights on at each extreme position); the pilot advances the supercharger controls slowly and retards them slowly several times. This moves warm oil through the propeller domes and to the supercharger regulators; it assures adequate lubrication of the turbine-wheel-shaft bearings and clears the balance lines for proper operation of the waste gates. At the same time the copilot runs the wing flaps all the way down and back up, checking against the flap indicator. Then the pilot retards the throttles to 1000 rpm. Pilot says, "Turbo-superchargers exercised." Copilot reports, "Propellers and flaps exercised."

Caution: do not exercise electronic superchargers.

*4. *Propellers?*

Copilot double checks to see that propellers are left in high rpm because governor limit lights also come on when propellers are in low rpm. Copilot announces, "Propellers in high rpm."

5. *Run up engines?*

Run up engines in the following order: 4, 3, 2, 1. Pilot advances No. 4 throttle until the propellers reach 2000 rpm and copilot checks all engine instruments. Copilot checks magnetos at a signal from the pilot. Technique: (a) Check tachometer for steady reading on both magnetos. (b) Turn ignition switch to Right magneto and hold for 3 to 5 seconds. Note any drop in rpm (max allowable drop is 100 rpm). (c) Switch back to Both and hold until rpm is steady. (d) Switch to Left magneto and check same as right. (e) Switch back to Both and leave there. During magneto check pilot should watch engine nacelle for excessive vibration. The difference in the rpm drop between the left and right mags should not exceed 40 rpm. The copilot reports "No. 4 magneto checked."

Double check.

Don't inadvertently leave ignition switch on left or right magneto.

Pilot now advances No. 4 throttle fully open, holding it with his right hand while he advances the supercharger control with his left hand until the manifold pressure starts to increase.

Precaution: this is the most sensitive point in supercharger regulation. Hesitate briefly to allow the turbo surge to balance out and to avoid initial excessive manifold pressure. As the manifold pressure climbs and stops, move supercharger control slowly open and you should get a direct, smooth increase to the desired manifold pressure. Set superchargers 1.5 inches below desired takeoff power, thus allowing for intake ram as speed increases on the takeoff run; this ram air will give full takeoff manifold pressure.

Run-up procedures with electronic turbo controls: when using the electronic turbo control, set the propeller governors in high rpm, checking the manifold pressure on each engine *separately* by advancing throttle to full open position and turning the dial of turbo boost selector clockwise to the number 8. If the manifold pressure on any engine fails to come up to within 1 inch of takeoff pressure, with full high rpm, turn dial to zero and check the engine rpm and manifold pressure without turbo boost. This will show whether the low manifold pressure is caused by faulty engine operation or by insufficient turbo boost. Also check the voltage with generators on.

If the engine is getting insufficient turbo boost, have the engineer adjust the boost on that engine.

(Note: you can save everybody time by doing this adjustment yourself. Remember to carry a screwdriver. On top of the electronic control box are four little caps which can be pried off, leaving each turbo adjusting screw open for adjustment. The turbo adjusting screws are located clockwise around the box, one in each corner. Sometimes the little caps get lost and the box is ready for screwing at the drop of a hat, so a good pilot should always be ready to screw, on the ground or mile high. On the contrary engine, open the throttle full; turn the electronic turbo control up to eight and insert your handy screwdriver, turning clockwise until the manifold-pressure gauge gives you the desired reading. If the pressure should be too high, simply turn gently counterclockwise until the reading is right. Once the lady gets a taste of this, she is apt to send an urgent signal for it at any time.)

After checking an engine on the No. 8 setting, return the dial to zero before retarding the throttle. After you have checked all engines, set the dial to No. 8 preparatory to takeoff.

Caution: when using electronic supercharger control always be sure generators are on and operating for takeoff. Pilot calls, "No. 4 run-up completed."

Repeat run-ups for Nos. 3, 2, and 1.

The combination of oil-line turbos and grade 91 fuel (training fuel during the war) caused some odd improvisation. When using grade 91 fuel, the spring-loaded stops for supercharger control levers do not allow sufficient travel to give you the extra manifold pressure needed in an emergency (in contrast with the settings for grade 100 fuel). To be on the safe side, use your finger for an additional spacer to provide necessary travel.

The first time I saw a grown man doing this, I actually blinked. It was about as precise as pouring

Formation, which is B-24s headed in the same direction.

84
64

two fingers of liquor in a glass, but as far as I know it always worked well enough for government use. My real complaint about oil-line turbos was when the lines got cold. Happily, the oil-line system of controlling the waste gates disappeared. Another odd bit of behavior disappeared with these hydraulically controlled turbos. Pilots were continually bending over the supercharger control quadrant using a pencil eraser to rub out pencil marks on the spaces by the control levers, then running the engine up to takeoff power, eyeballing the position of the lever carefully, and marking a clear pencil mark at that point. The method was fallible, as I frequently noticed the dismaying difference a few minutes later at takeoff when all aboard fervently hoped the superchargers were behaving decently. Again I suggest that the mourning was not noticeable when the oil-line hydraulic wastegate controls passed from the scene.

*6. *Lock superchargers.*

Pilot sets friction lock so that levers may be readily moved but will not creep back from vibration. Remember that the throttle and supercharger locks are in reality friction brakes and should be treated as such, meaning, among other things, that you have to watch them to keep them from creeping. Pilot calls, "Superchargers set and locked."

*7. *Gyros?*

Pilot makes a final check, noting any precession since taxying from the line, and resets for takeoff. Pilot announces, "Gyros uncaged and set."

*8. *Wing flaps?*

Copilot runs wing flaps down to 20 degree position and calls, "Wing flaps 20 degrees."

*9. *Flight controls?*

To check full travel and freedom of movement, the pilot moves the controls to full forward and right on the wheel, right rudder; then he moves them full back and left on the wheel, left rudder. Pilot calls, "Controls checked for full travel and free movement."

*10. *Doors and hatches?*

Engineer closes doors and hatches, reporting, "Doors and Hatches Closed."

*11. *Auxiliary hydraulic pump and power unit?*

All checklists agree that the engineer shuts off the auxiliary power unit to avoid a fire hazard on takeoff. Some checklists say to turn the auxiliary hydraulic pump off for the same reason, reasoning: the a.h. pump is the only open-brush motor in the bomb bay, and the cooling fan tends to draw any gas fumes into the motor. Therefore, the engineer turns it off and reports, "Auxiliary hydraulic pump and power unit off."

Other students of B-24 operations ask what the auxiliary hydraulic pump is for. They point out that takeoff is a high-demand time for hydraulic pressure. If the engine-driven pump fails or if No. 3 engine fails, the auxiliary pump is the only source of hydraulic pressure, so they urge this procedure: leave the pump on for takeoff. Have the engineer, just before takeoff, open the bomb-bay doors slightly to ventilate the bomb bay. Then after takeoff, the engineer steps back once more and opens the bomb-bay doors again to ventilate the bays. Then he turns off the auxiliary hydraulic pump. Some bomb groups prescribed the latter. Consolidated Aircraft Company put out a film on operation of the B-24D in which they simply prescribed takeoff with the pump On.

Next time you fly the bird, make your own decision.

*12. *Generators?*

The engineer turns on all four generators and stands by the panel to turn off any generator indicating excessive load. If this is necessary, he waits until the other generators show signs of sharing the load before returning the off generator to the line; he switches it off again if it fails to equalize. But all being well, the engineer calls, "Generators on."

*13. *Cowl flaps?*

Copilot closes them to trail position and calls, "Cowl flaps at trail."

See that cowl flaps are all closed the same. If they are open too much, they will cause loss of lift, increased drag, and severe flutter of the tail surfaces. It is better to have cowl flaps completely closed than too far open. Engines may idle at 1000 rpm for a reasonable time with cowl flaps closed and not heat up. Don't take off if any head temperature is less than 150°C or more than 232°C. Desired level is 205°C.

Note: each degree of cowl-flap opening causes .8 mph loss of speed.

*14. *Booster pumps?*

Copilot turns all fuel booster pumps on. This builds up a differential of 8 lbs. in the rubber lines to the engines, thus keeping them from collapsing. It is also a safety precaution in case of engine-pump failure. Copilot reports, "Booster pumps on."

Note: carburetor-air filters. When carburetor-air filters are being operated because of serious dust conditions, air normally taken in through the air scoop in the engine cowl is blocked off and air is taken in through the back of the engine nacelle through the air filter. Thus air comes to the supercharger at a lower pressure because of friction in the filter and because there is no ram pressure from acceleration of the airplane. For this reason it is necessary to set the supercharger at the desired takeoff setting with no allowance for ram pressure.

Remember that the turbo wheel is turning faster to produce the same manifold pressure because of the loss of pressure through friction in the air filters.

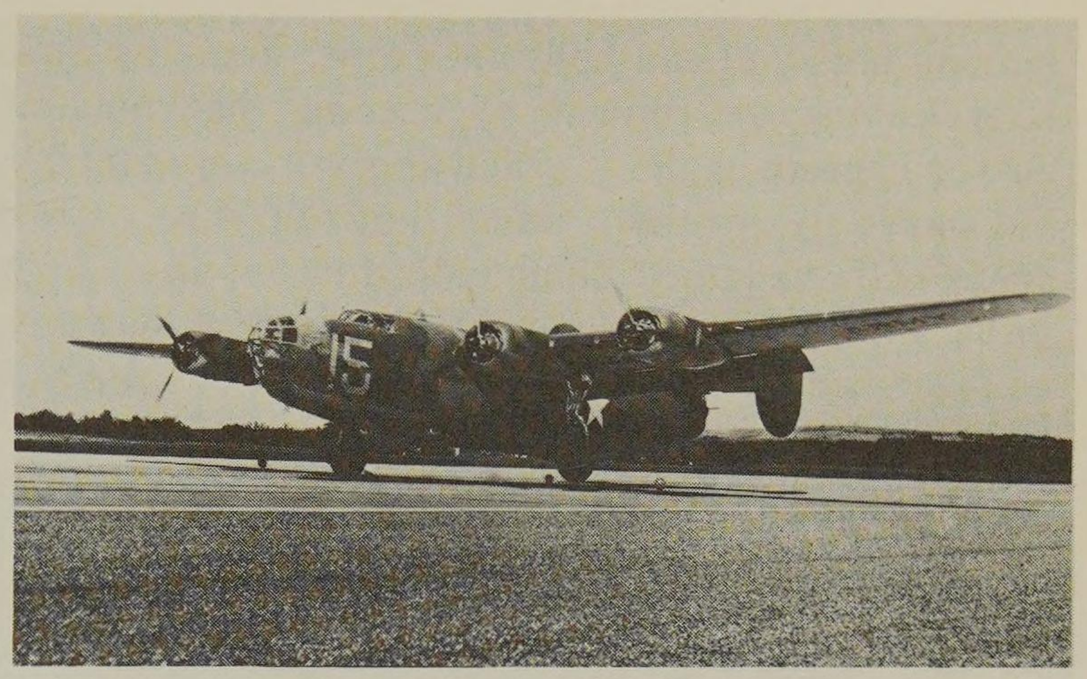
Caution: turn carburetor-air filters off as soon as you are out of the dust area (never leave them on above 12,000 feet) because there is a possibility of exceeding the turbo-wheel speed limits.

(Another "I remember": in early 1944 I flew across the Sahara Desert on the leg between Dakar and Mar-

rakech, here passing through a great yellow cloud of dust for some hundred miles and perhaps two miles high. To turn on the carburetor-air filters or not? I knew why they were bad — the tech order told me the horror stories. I left them off when I studied the blue sky above. Maybe the engines weren't damaged; they performed well for many hours thereafter. I never had another chance to try out the carburetor-air filters.)

Now, having completed the before-takeoff checklist, I am sitting up there in that left seat; and the instructor is looking only slightly dejected.

* * *



A B-24D with narrow-bladed propellers (later props were called paddle props).

Takeoff:

Takeoffs in the B-24s came easy to me, possibly because I had excellent instruction. I had also done my reading and had spent a large chunk of apprentice time on the flight line watching takeoffs and landings. Even the book says takeoffs are easy, provided. . . . Tricycle gear improves both the takeoff and landing characteristics. Before you get in the bird, make sure your runway is long enough, considering field elevation, temperature, wind, and gross weight (study the takeoff chart). And be sure there are no obstructions along your takeoff leg.

Taxying into position: Get your clearance from the tower, or control, to line up on the runway. Take a good look for aircraft and taxi out in a wide sweep, using a minimum of runway for straightening the nose wheel. Stop the airplane lined up straight ahead, hold your position with the brakes, and set all throttles at 1000 rpm. Both pilot and copilot should make a quick check on all instruments. Then copilot obtains a radio clearance or you get the proper signal from control and you are ready for the takeoff run.

The takeoff run:

1. Release the brakes and slowly but steadily advance all throttles together. Learn to apply power at the speed engines can readily take it. Never jam or stiff-arm the throttles.

2. If you start to move to the left of the middle of the runway, lead the throttles on the left and vice versa. Don't stop the opposite set of throttles, but instead lead all the throttles progressively. In this manner you can build up speed rapidly and obtain rudder control quickly. Don't attempt to control direction on takeoff by use of brakes. Expert pilots, however, may use a tap of brakes at the very beginning of the roll to set the nose straight, but they never use brakes after the airplane gains momentum. If you are good enough, you can lead upwind throttles in a considerable blow without resorting to brakes.

3. As soon as you have rudder control, use it. Come in with lots of rudder to hold your line down the runway, rather than using unnecessary buildup of power on one side.

4. Copilot follows throttles through with his left hand, and as soon as they are against the stop, he sets the friction lock to prevent throttles from creeping but so they can easily be moved.

Note: Pilot's hand should be on the throttles throughout the takeoff except when necessary to trim the plane or signal the copilot. Whenever pilot's hand leaves the throttles, copilot should hold them.

Copilot should closely observe all instruments (particularly manifold pressure and rpm). Use full throttle on takeoff. This shortens the run and minimizes wear and tear on tires and gear. Manifold pressure should not exceed 49 inches for grade 100 fuel, or 42.7 inches for grade 91 fuel, and propellers should not exceed 2700 rpm. Power reduction necessary to keep within manifold-pressure limits should be made with the throttles and not with the turbo regulators.

5. As your speed increases to 70 or 80 mph so that you have elevator control, ease back on the control column enough to relieve the nose wheel of its weight. When full weight is on the nose wheel, the wing is at a negative angle of attack; lifting the weight puts the wing in the desired slightly positive angle of attack.

6. Hold this attitude straight down the runway. The airplane will fly itself off the ground at 120 to 130 mph. Don't haul it off. Increase the back pressure just enough to establish a positive shallow climb and hold it.

7. Don't become overanxious about building up climbing speed. It takes time for the power of the propeller thrust to overcome the inertia of a heavy airplane. Beware of lowering the nose below level flight to build up airspeed. This changes the lift and tends to fly you into the ground. Always make all changes of attitude gradually, a little at a time. Make small, smooth changes rather than large ones. As your airspeed increases, relieve heavy fore or aft control pressure by trimming.

If you set the artificial horizon properly before takeoff, with the miniature airplanes slightly below the

horizon bar, you can hold the proper angle of climb after leaving the runway by keeping the miniature airplane approximately ⅛ inch above the horizon bar, but never fly by the artificial horizon alone. Cross check with the rate-of-climb indicator, but be aware of its lag and initial tendency to show a descent right after you get off the ground. Always go to airspeed. Be sure not to let it increase too rapidly but don't freeze it at takeoff speed. If you haven't yet learned that you are now serving the god of airspeed, and if your parents never told you, now is the time to start absorbing that truth, which will soon be everywhere apparent. I have heard the saying among pilots who fly heavy airplanes, or those with high wing-loading, as a criticism of a pilot, "He likes his altitude a little much." They mean that airspeed rules, that it will do more for you than anything, except, maybe brains and guts. Sit in adoration before that airspeed indicator and satisfy its demands.

But back to the takeoff leg. Establish and hold proper attitudes in the B-24 by reference to flight instruments rather than to outside objects. It's an instrument plane.

8. Attain a minimum airspeed of 140 mph and a safe altitude above all objects before your first power reduction.

After-takeoff check:

1. Wheels

Copilot raises wheels on audio visual signals from the pilot, who calls, "Gear up," and signals visibly by raising his right hand, thumb up. As soon as the gear handle is in the Up position, the pilot stops the rotation of the main wheels by a smooth, firm application of brakes. This reduces the strain on the main-gear suspension assemblies caused by the gyroscopic action of the rapidly rotating wheels. Rough application of brakes puts undue strain on the gear fittings and may rupture an expander tube.

Caution: There is no hurry about raising the wheels. Be sure you have plenty of airspeed and altitude before you start them up.

Press the button: when the copilot raises the gear, he should be sure first to unlock the safety button on top of the gear handle by pressing it down. Forcing the handle against the lock will injure the locking pin.

If the solenoid latch does not release, you can push the releasing pin in with a screwdriver and then raise the gear handle to bring the wheels up. The latch is located behind the pilot's instrument panel just forward of the pedestal. *Don't try this on the ground because you will retract the gear and the airplane will crash down on its belly.*

2. Superchargers

When the airplane attains safe airspeed and altitude, the pilot makes the first power reduction with superchargers and sets them for normal climb (not to exceed 46" for grade 100 fuel or 38.5" for grade 91 fuel).

Power reduction with electronic turbo control: turn the turbo-control dial back to the left toward zero until you reach the desired manifold pressures listed above. If the turbo control is operating properly, it will automatically maintain the setting throughout the climb.

3. Throttles

If manifold pressure remains higher than desired for climb after superchargers are all the way off, then reduce throttle to obtain climbing manifold pressure.

4. Propellers

Copilot reduces rpm to 2550 rpm when directed by the pilot.

5. Wing flaps

Copilot raises them when directed by the pilot. Don't raise the flaps before you have 500 feet of altitude and 140 mph of airspeed. Remember that changes in flaps change the lift effect of the wing. As you raise the flaps, raise the nose of the airplane to correct for the change in attitude. Use enough back pressure to maintain altitude, and the airplane will rapidly accelerate to 150 mph. Don't lower the nose to gain speed because this will result in unnecessary loss of altitude. Add nose-up elevator trim to help maintain your altitude.

Warning: Don't be in a hurry. Get a safe airspeed and a safe altitude before you raise the flaps. But don't exceed 155 mph with flaps down.

6. Auxiliary hydraulic pump

If you took off with the auxiliary pump on, tell the engineer to go back, crack open the bomb bay for ventilation, and turn the pump off, closing the bomb bay doors again afterward. Engineer returns and reports, "Auxiliary hydraulic pump off."

7. Booster pumps

Copilot switches them off one at a time above 1000 feet and notes any drop in fuel pressure.

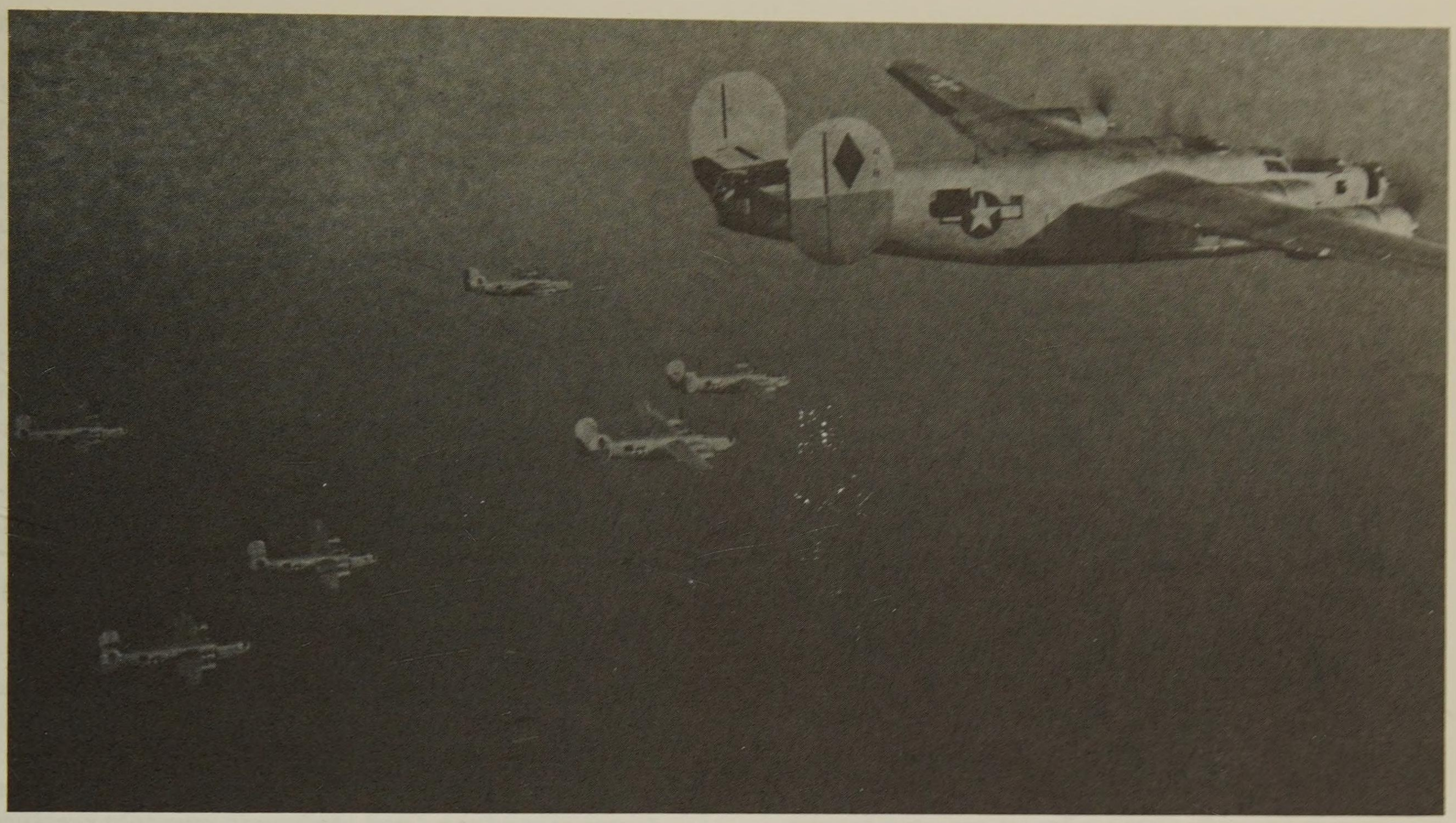
8. Cowl flaps

Cowl flaps will normally be at trail for climb. The copilot checks cylinder-head temperatures and, if they are above 260° on any engine, adjusts them as required. Opening cowl flaps more than to trail causes much drag; when possible, an increase in airspeed is preferable.

Important: The copilot reads the after-takeoff checklist when the gear and flaps are up, the first power reduction is made, and when a safe altitude and an airspeed of 150 mph are reached.

The climb:

Now that we have the airplane off the ground, the instructor is cheered by the very act of flight. Later we'll take the bird off under other than normal conditions, but now let's take the lady on up and get some flying time, then approach and land.



A B-24 formation over Europe. (The lozenge on the horizontal stabilizer suggests the 454th Bomb Group — the author's group.)

Unless you have obstacles to clear, set the best climbing speed — 150 to 160 mph — and trim the airplane to take the weight off the controls. I like to climb at 160 because the engines run cooler. Now your talented copilot can synchronize the propellers, an act which takes some expertise and which we'll cover later. For now, simply watch your instruments, watch for other traffic, and practice smooth flying technique.

Auto-rich for all climbs: through all climbs, mixture controls should be in Auto-rich; at high power, the proportion of fuel to air must be relatively high to suppress detonation and assist in cooling.

Effects of increasing altitude: as you climb, the engines are generating more and more heat, which is reflected in cylinder-head temperatures and oil temperatures. Outside air temperatures are normally falling at a lapse rate of 3.6° per thousand feet; atmospheric pressure decreases; less oxygen is available from the thinning atmosphere. All these affect your airplane and crew.

Engine heat

1. Cylinder-head temperatures: adjust cowl flaps to control these head temperatures, which normally will run about 232°C but should not exceed 260° or fall below 150°C.

2. Use of cowl flaps: the position of the cowl flaps seriously affects your rate of climb because of added drag and disturbance of the air flow, so much so that your airplane may not climb above 23,000 feet with cowl flaps only slightly open. Cowl flaps open from 10 20 degrees will sometimes cause severe tail buffeting. The tech order suggests that if necessary to use more than 10 degrees to maintain cylinder-head temperatures within limits, try opening them farther until the tail buffeting stops. (Oh, me. This is like taking more poison to palliate problems. I beg you to try a different cure.) You already know something of the omnipotent one — Airspeed. Try closing those cowl flaps and increasing the airspeed. Of course, you are tied to the leader's airspeed when you are in formation.

In a combat formation the leader's airspeed will be 150 mph; you'll be heavily loaded, and you'll have to pull a lot of power for a long time. You are, to put it mildly, between a rock and a hard place. You know the importance of the mission, that this is where it all pays off. You wonder why you ever let Laurel or Hardy talk you into this fine mess. What you do is sit watching the cylinder-head-temperature gauges and hang in there. Have the copilot bite his nails. When you reach bombing altitude, you won't get any real relief, for it takes much power to hang in there at high altitude. But you take a stoic attitude, telling yourself that what will be, will be. Be cavalier; shrug and say, "Melt 'em off." Soon fighters will make you lose track of gauges anyway, then flak will make you forget everything except that leader's wing you are hanging onto. When the bomb bays open, the temperature inside the bomber drops suddenly to forty below zero, fahrenheit or centigrade — take your choice. How can the engines be

that hot when your sweat has frozen your flying suit to solid ice? Oh to have a little of that engine temperature inside the fuselage, or to be at home in your bed. But if you don't catch fire or get shot down, the bombs will go out; the power will come back, and the cylinders will cool. . . . What a round we got into over cylinder heads heating up on the climb!

But even if you catch fire, it'll likely only be one engine. We'll talk later about handling that. And with any luck, friendly fighters will give you an escort back to the Adriatic. A remedy usually comes along; if not, you can always sing the old Air Corps ballad, "You will never mind." Keep your engines cool, serve the god of airspeed, and go back to the climb.

3. Oil temperatures: oil temperatures can be reduced more quickly by decreasing engine rpm along with throttles than by reducing throttles alone.

4. Other methods: increase airspeed by 5 or 10 mph. This won't cause much loss in rate of climb.

In case of extreme cylinder-head and oil temperatures, use *emergency* Full rich mixtures (with Bendix-Stromberg carburetors). This will dissipate the heat very rapidly but will also cause a loss of power and excessive gas consumption. Use only long enough to reduce temperatures. Excessive temperatures are sometimes caused by failure of the automatic features of Auto-rich. Full rich corrects this because it gives a fixed mixture.

Decreasing air temperature

1. Carburetor-air temperature: on an extended climb when the relative humidity is high, check regularly to be sure that the carburetor-air temperature is either above or below the icing range (-5°C to -15°C). You can get carburetor ice with little or no warning.

2. Intercooler shutters: hot compressed air comes to your carburetors from the superchargers through the intercoolers. Intercooler shutters are kept in the open position to cool this compressed air. It is practically never necessary to close intercooler shutters except in very severe carburetor-icing conditions (see carburetor icing in the friendly tech order). If you do close them, keep a close watch to see that carburetor-air temperatures and cylinder-head temperatures don't suddenly rise beyond limits. Intercooler shutters should always be used with utmost caution to avoid overheating.

3. Heater: remember that there are crew members all over the airplane who may be getting cold. Ask them if they want some heat. The longer you can keep them warm, the more effective they will be with their headwork, their bombs, and their guns. Crew comfort is important to crew efficiency.

Decreasing atmospheric pressure

1. Airspeed indicator: decreasing atmospheric pressure causes your airspeed indicator to show an airspeed lower than your true one.

2. Manifold pressure: the density and pressure of the outside air decrease as altitude increases. At sea level normal atmospheric pressure will, on some engines, be enough to maintain the desired manifold pressure. As altitude increases, and full throttle fails to give sufficient manifold pressure, you add boost with the turbo-superchargers.

Note: With the oil-type turbo regulator, when climbing at a given throttle setting, rpm, and turbo-regulator setting, the manifold pressure will increase slightly as altitude increases because the atmosphere has less back-pressure effect in relation to the constant exhaust pressure. This results in a steady increase in turbine-wheel speed and thus in increased manifold pressure.

3. Turbo-supercharger (oil type regulator):

a. Establish initial manifold pressure with full throttles. Get additional boost from turbo-superchargers.

b. Reduce manifold pressure by first reducing the turbo-supercharger regulators completely and then, if further reduction is necessary, reduce the throttles. (Takeoff is an exception to this because the copilot can better control the small changes in manifold pressure with throttles.)

c. At altitude there is a tendency for the turbo-wheel to overspeed. The critical altitude at maximum climbing settings will vary with the type of fuel — 30,000 feet for grade 91 and 27,000 feet for grade 100. It will be necessary to reduce the manifold pressure 1.5" for every 1,000 feet of climb above these critical altitudes. If climbing at less than the maximum manifold pressure, you can raise the critical altitude by 1,000 feet for each 1.5" that your manifold pressure is below the maximum. Thus, if the critical ceiling is 27,000 feet at 46", it will be 29,000 at 43", etc. Then you would continue to decrease manifold pressure 1.5" for each 1,000 feet above 29,000 feet. (This applies where overspeed governors are not installed.)

4. Booster pumps On at 10,000 feet: as you climb and the atmospheric pressure decreases, there is more and more tendency for a vapor lock to form and for suction from your engine-driven fuel pumps to collapse the rubber fuel lines. Booster pumps put 8 lbs. additional pressure in the lines to help support them. Turn the booster pumps on at 10,000 feet and keep them on until you descend below that altitude.

5. Crew: as altitude increases, your crew is becoming less efficient. Their ears tend to bother them. Head congestion may cause severe pain. They are getting insufficient oxygen. Always use oxygen above 10,000 feet.

The importance of smooth flying: smooth, steady flying, proper trim, and minimum horsing of the airplane become more and more important to maximum performance as altitude increases. Steady, expert fly-

ing will reduce your fuel consumption, increase your rate of climb, and reduce wear and tear on your engines.

Remember that the only way you can maintain a constant attitude, steady climb, and smooth flight in the B-24 is by reference to instruments.

Leveling off:

Always level off for cruising *from the top*, in both speed and altitude, the purpose being to let the airplane build up full momentum for cruising. If you go directly from a climb to level flight with a B-24, and reduce power, it will mush along at a high angle of attack and in a high drag attitude while failing to achieve its best cruising speed. The heavier your load, the more important it is to level off properly.

Leveling off procedure:

1. Continue your climb to 500 feet above the desired cruising altitude.
2. Level off; drop the nose slightly to get on the step and pick up speed.
3. Reduce power to cruising setting and gradually descend to your cruising altitude.
4. Synchronize propellers and trim the airplane.

Cool off the engines: remember that throughout the climb the engines have been generating heat. Give them a chance to cool down somewhat below desired cruising temperatures before you change mixtures to Auto-lean, allowing cylinders, blowers, and rear sections to dissipate heat. When the mixture is leaned, a well-cooled engine is less likely to detonate than a hot one.

Unless the cylinder-head temperatures are still near the maximum, close the cowl flaps; the engines will cool faster with the increased airspeed.

How to synchronize propellers, or Chasing shadows:

Brace yourselves now, copilots, and defer this task no longer; the pilot is already very tired of listening to the unsynchronized beat of the propellers, and his lovingkindness will show through when he hears that sweet, harmonious sound of tamed horses all singing in one voice. Easy when you know how, hard when you first try, synchronizing has called forth essays from most Liberator schools and deep curses from people who try it for the first time. I once had a copilot who, when I complained about his imperfect job of synchronizing, said, "Aw, Will. That's close enough." That was not the last word on the subject.

To get the sweet sound, one must chase shadows. The copilot starts by bringing the tachometers to the desired rpm setting with the propeller governor control switches, four spring-loaded toggle switches. A gang toggle moves all four control switches to make a quick major adjustment. On most 1944 airplanes two two-gang toggles control right and left pairs of propeller controls. With the appropriate two-gang toggles the copilot quickly gets the left engines and the right engines to agree on the tachometer and on sound (approximately — he gets the heavy beat out of the props). Using single toggle switches our operative sets the exact rpm reading on each engine, here eliminating the wild uncoordinated beating of the propellers. But not completely. The only agreement is in the tachometer readings. For actual agreement, the clever-handed dude on the toggles must now chase shadows visually, starting, say, with the No. 1 and No. 2 props. Leave No. 2 as it is. Looking through the blades of both props, note the rotating shadows around the top half of No. 1 prop. If the shadow is rotating away from you, No. 1 is too slow and rpm should be increased; naturally, if the shadow is rotating toward you, No. 1 is too fast and rpm should be decreased. When the shadow disappears, the left-hand engines are synchronized. Then, looking through No. 3 and 4 propellers, leave No. 3 as it is. Note the rotating shadow and follow a reverse procedure. If the shadow running through No. 4 is rotating away from you, it is too fast and rpm should be decreased. If the shadow runs toward you, the propeller is too slow and rpm should be increased.

You can keep this sorted out by remembering that the propellers turn to the right. From your seat in the cockpit, No. 1 is turning toward you and No. 4 is going away from you. If the shadow is going with the propeller outboard, the propeller is too fast; if the shadow is coming backward against the propeller, then the propeller is too slow. The old manuals had a mnemonic device which was supposed to help, but it only adds another little rhyme to remember wrong — you know, thirty-one days hath November, except in leap year. If you are synchronizing several times a day, you'll remember. If you only go at the shadow-chasing rarely, you'll remember instantaneously when you see the shadow speed up. You simply toggle the other way.

Now you have some trouble. A touch on this electrically stimulating toggle changes the rpm by, say 50 rpm. A touch takes you too far, and the shadow starts going the other way. Here you have to chase the shadow the other way — worse than going from sand trap to sand trap, back and forth across the golf green. Nobody said it was that easy. Remember, that toggle switch, once you get close, will at the next touch carry you beyond the desired setting. If the shadow is almost gone, I sometimes intentionally speed it up, then go back the right way. It works, frequently, because the smallest electronic signal moves the rpm more than desired. But persevere.

To synchronize at night, use a flashlight to observe the shadows. Or use the landing lights. If you really become deft at this job, you may be able to rely on sound alone.

You probably aren't through when the shadows are gone. If the sound is still wrong, then the left-hand engines are not synchronized with the right pair. To correct this, go to the tachometer readings. Perhaps one pair will be indicating more or less than the desired rpm. If adjusting the rpm harmonizes the sound you are nearly through. If you still hear a beat, move the pair until you get the harmonious sound. Look back through the props of the adjusted pair. Shadows? Go back and chase the shadows from the pair again. When this last shadow is gone, you've got it. By George, you've got it.

About this time, Air Traffic Control assigns you a new altitude, so you'll get more practice at chasing shadows.

Trimming:

Trimming the Liberator is easy but important to the operation thereof. Brawny pilots can wear themselves out by failing to trim properly and frequently enough. Poor trim cuts down the airspeed and, naturally, increases fuel consumption. Formation flying becomes terribly tiring when the airplane is out of trim.

Trim the B-24 by instruments, not by outside reference. You must keep a sharp watch, however, for other traffic, for a well-trimmed airplane cannot by itself avoid a collision. The following procedure is the easy way to trim the airplane for straight-and-level flight.

Balance the power: see that you have synchronized propellers and equal manifold pressure on all engines.

Elevators:

1. Check that the altimeter and rate-of-climb show steady, level flight; reset the flight indicator if necessary for level flight.
2. Hold the airplane level with reference to the flight indicator and adjust the elevator trim to relieve any fore-and-aft pressure required to hold the nose level.

Rudders:

1. Hold the wings level with the ailerons by reference to the flight indicator and trim out all rudder pressure,
2. Watch the directional gyro to see if the airplane is turning. Gradually correct with rudder trim until the directional gyro holds a steady course straight ahead.

Ailerons:

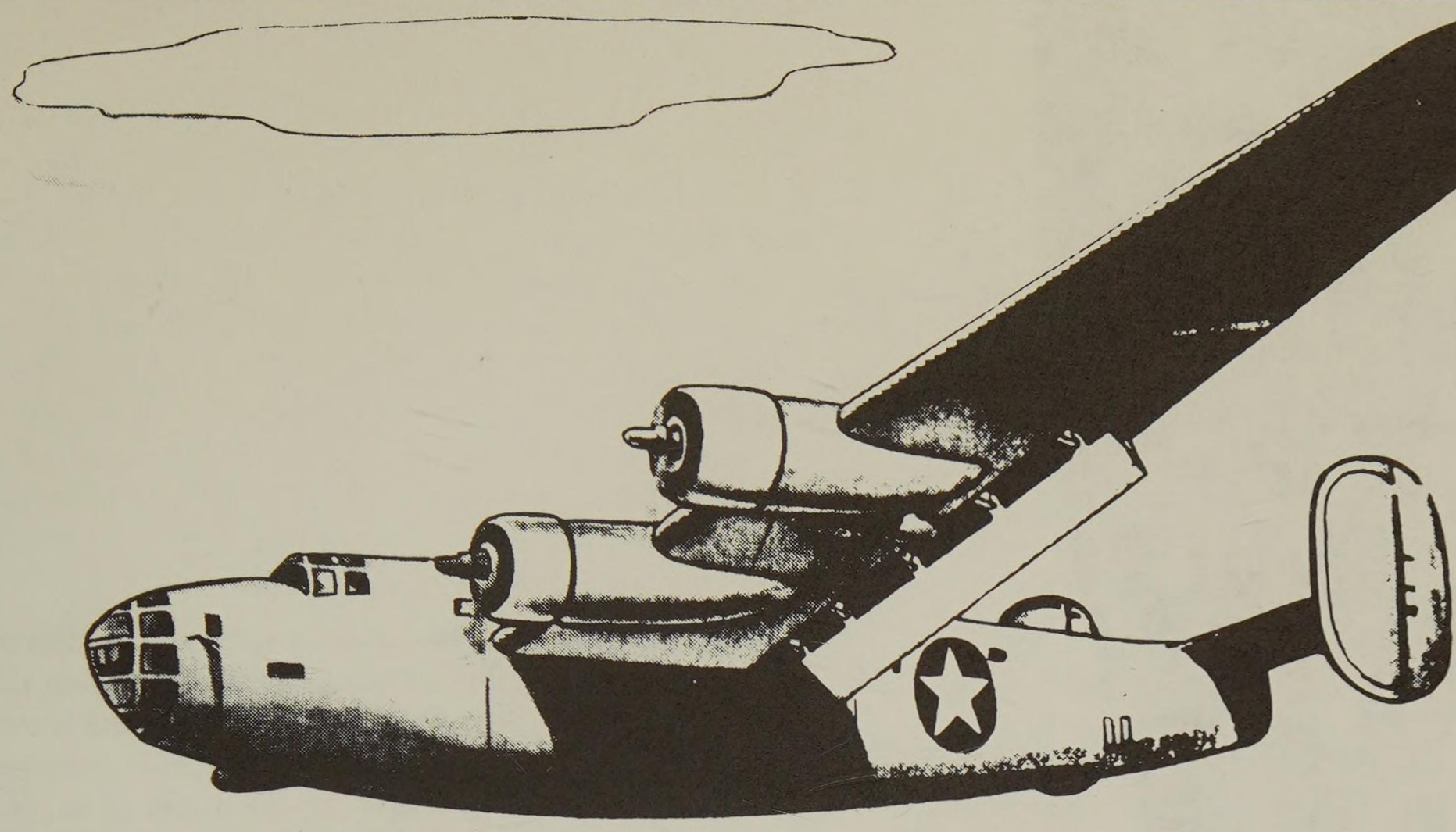
1. Level the wings; hold a gyro heading with rudder and release the wheel.
2. If the flight indicator shows a wing is dropping, correct with aileron trim.

Double check: finally, check the directional gyro, flight indicator, and needle-and-ball with hands and feet off controls to make sure of proper trim. Once the airplane is properly trimmed, small adjustments will usually keep it there. Trimming should become automatic.

When to trim: trim at the first sign of excessive control pressure. Trim for climbing, descending, for gear down or up, for changes in flap setting, when the crewmen change positions, as fuel is used up, when bombs are dropped, in case of engine failure, and the like.

Relationship of load and trim: if the airplane is perfectly loaded, it is possible to fly it hands off with one or two degrees of tab setting. On long flights, trim becomes quite important. A loss of a few miles in airspeed can result from a single degree of tab on one surface. If the plane is improperly loaded, it is thus worthwhile to shift cargo to get better balance.

Don't hold pressure manually instead of trimming.



USE FLAPS FOR CRUISING——AND BE SORRY!

Drag Your Flaps
And Waste Your Gas
Across the Plains
You'll Drag Your Can

On Maneuver
Dragged His Flaps
Good Thing He Wasn't
Hunting Japs

Humor from the ***Flight Manual B-24D Airplane,*** *15 Sept. 1942.*

4
Cruising

Now that the clever pilot has herded this *system* into the air and has achieved a desired altitude, he can mop his brow and prepare for what is sometimes called the boring part — moving the bird to a desired destination. But there is much to do, and if it is done well, this middle phase can be routine. Terror comes when it is done badly. The flight plan is usually prepared by the navigator, a chore he can do well only after being given a good deal of information about the desired objective: destination and some of the conditions involved.

Cruising Power Settings

Setting	Mixtures	RPM	MP	BMEP*	HP
Grade 91 Fuel — Specification ANF-26					
Normal	Auto-lean	1650-2100	30	—	—
Local	Auto-lean	2000	30	131	610
Grade 100 Fuel — Specification ANF-28					
Maximum	Auto-rich	2325	35.5	150	820
Maximum	Auto-lean	2200	32	140	715
Desired	Auto-lean	2000	30	131	610

All cruise powers may be used continuously.
For maximum-range settings, see cruise-control charts.
*Brake Mean Effective Pressure

Normal Automatic-Lean Pressures and Temperatures

Cylinder-head temperatures:	232°C Maximum
	205°C Desired
Oil temperatures:	100°C Maximum
	75°C Desired
Oil pressures:	65 to 100 lbs./sq. in.
Fuel pressures:	16 to 18 lbs./sq. in.

If instruments read within these limits, and power settings accord with tables, the pilot directs the copilot to move the mixture controls to Auto-lean, one at a time, and to note the effect on temperatures and pressures. Carburetor-air temperatures should stay below 35 degrees C. If an engine gets hot in Auto-lean, go to Auto-rich long enough to cool it down, then return to Auto-lean. If the engine heats up again, go to Auto-rich and leave it there. Write up the malfunctioning automatic feature in the Form 1A.

Superchargers: at low altitudes, you may have enough manifold pressure to cruise with superchargers completely off, but you'll need to keep the superchargers operating to prevent induction-system icing when flying in low temperature and high humidity. Do this: reduce manifold pressure 4'' with throttles, then add 4'' manifold pressure with superchargers. If you are above 20,000 feet and operating below 1800 rpm, superchargers won't function properly. Here is your chance to make a command decision. Which is more important — cruise control or prevention of induction-system icing? Weigh the factors and make the decision.

Cowl flaps: the closed position reduces drag and increases speed, but if you can't get the cylinder-head temperatures down to desired, use the cowl flaps.

Directional gyro: check for precessing and reset every fifteen minutes or as necessary.

Instrument checks: call for the copilot to make a complete instrument check and report his findings at regular intervals. No problem for him — he cruises those instruments constantly. Also have that troop keep a record of aircraft performance so you'll know the creature better.

Visual checks: have the engineer make an hourly visual check of turbos, cowl flaps, nacelles, fuel-cell areas, and the like. He has to go to the rear of the airplane for some of these, so he'll have to carry a walk-around oxygen bottle at atltitudes above 10,000 feet.

Oxygen: as you pass through 10,000 feet, require all crewmen to go on oxygen. Have the copilot monitor compliance by requiring each man to report in on interphone every fifteen minutes on his wellbeing and the amount of oxygen available to him.

Flying the airplane: since you want every person in the Air Force to know that you are the best of the best, use cruising time for practicing the perfect techniques, some quite basic:

Trimming: keep the airplane perfectly trimmed all the time. Your day will be less tiring and you'll end the mission with enough fuel — a reward in itself.

Heading: hold your heading carefully: advise your navigator of every change so he can do his job well.

Altitude: Hold your altitude carefully. If you wander

A B-24D in combat-organization markings.

even a little, correct back to your chosen height. Don't be satisfied with a 200-foot error.

Airspeed: as time passes and your load of fuel lightens, airspeed increases slightly. Keep your airspeed constant in accordance with your flight plan, even though you have to reduce power.

Flight Characteristics

The aircraft manufacturer and the Army Air Forces have already told you that you are flying a fine airplane, but watch out for some things which come out as less than ideal. Don't, however, admit these to B-17 pilots, who report only the perfections of the Fortress. Of course the good things public-relations people report are all true, and more and better besides.

Inherent directional stability: just keep the bird trimmed. Of course the controls are heavy, as they should be on a heavy airplane, but the well-trimmed bird is easier to fly. But see the discussion on nose hunt below.

Longitudinal stability: the company men quickly tell you that longitudinal stability is excellent. So it is, unless the center of gravity is forward or aft of the ideal. You really can stall it and it will recover itself within reasonable centers of gravity. In such cases, do what you should at any time: fly smoothly.

Characteristics in rough air: the book tells you that intelligent pilots avoid violent turbulence. I too recommend this course; my trouble is that I don't always know how to do it. I always *try* to avoid violent turbulence. The surest way is not to fly, but then you'd miss the whole flying game. I don't know of a military airplane that hasn't had one of its types brought down by turbulence. The best course requires luck, with knowledge, which comes from good advice and experience. Fortunately, the Liberator rides rough air easily. As the good men in instrument school taught you, attitude is primary. Keep the bird level. In the B-24s, responses to your pressures come slowly, so give the old girl a chance to show you her inherent stability. In extremely rough air, reduce airspeed. The book even suggests lowering the landing gear. But Airbird Annie says: Get out of extreme turbulence, unless it makes Hitler, Mussolini, and Tojo cheer.

Don't fly contact: the pilot's manual quips: the only reason they put windows in the aircraft is so you can see other aircraft and mountains and tell whether or not the sun is shining. Fly this instrument airplane by instruments, day or night, fair weather or foul. But keep a sharp lookout.

Nose hunt: what the publicitiy troops fail to mention is that the nose of the B-24 hunts, within limits, in all directions, when cruising. Work as you will to trim out all nose hunt, you'll never succeed. It hunts in slow arcs, up and down, side to side. When the mighty Liberator is well trimmed, it holds course, altitude, and attitude, *on average*. It climbs twenty feet, descends twenty feet. It turns a couple of degrees left, turns three degrees back right. It combines these moves and arcs, sometimes limiting the deviations to a degree or to ten feet. It just hunts. But don't let it get you; irritating as it may be at first, learn to accept it or spend the rest of your life trimming back and forth. Mention nose hunt to an old B-24 pilot and he'll likely have forgotten about it. He simply learned to accept it. I perhaps remember it because I tried for perfection too long before I accepted the condition.

Flight Restrictions

At No Time Will The Following Maneuvers Be Attempted

LOOP

ROLL **SPIN**

INVERTED FLIGHT

IMMELMANN

VERTICAL BANK

Remember that all the pilots were young in World War II, just out of flying school and likely frustrated because they weren't assigned to the free and happy life of fighter pilots. Flight restrictions like those above had to be written in large capital letters and bordered in red. Similarly, explicit and simple directions were featured as "Always" and "Never" instructions:

Always:

Always follow all items on checklist.
Always check fuel before takeoff and regularly during flight.
Always check nosewheel accumulator — if provided.
Always use battery cart when available. (Always disregarded)
Always open intercoolers for starting.
Always check generator switches Off when starting.
Always use Auto-rich except when cruising.
Always check de-icers Off before takeoff or landing.
Always use outboard engines for steering when taxying.
Always turn Off auxiliary hydraulic pump before takeoff. (Sometimes ordered always the other way. See earlier discussion)
Always check gear latches engaged before landing.
Always check the automatic pilot Off before takeoff or landing.

Never:

Never execute prohibited maneuvers.
Never exceed airspeed restrictions.
Never start engines before pulling props through.
Never start with low batteries.
Never start with auxiliary power unit alone.
Never start with superchargers On.

Never use starter for direct starting. Inertia flywheel must be energized before meshing.
Never attempt to use intermediate positions on mixture controls.
Never turn on ground too sharply. It will damage landing gear and tires.
Never attempt to take off with props in low rpm.
Never transfer fuel with radio On.
Never apply brakes with nosewheel off ground.
Never land with brakes locked.
And never, never put beans up your nose while Mommy's gone. (Wait till she comes home)

Airspeed Limitations

Limiting Factor	*Maximum Indicated Airspeed*
40 degrees flaps	155 mph
10 degrees flaps	180 mph
Lowering landing gear	155 mph
41,000 lb. gross weight	355 mph
56,000 lb. gross weight	275 mph

Automatic pilot: do not use the autopilot when flying at less than 155 mph or when flying in turbulent air.

Extremely turbulent air: slow down to 150 mph IAS.

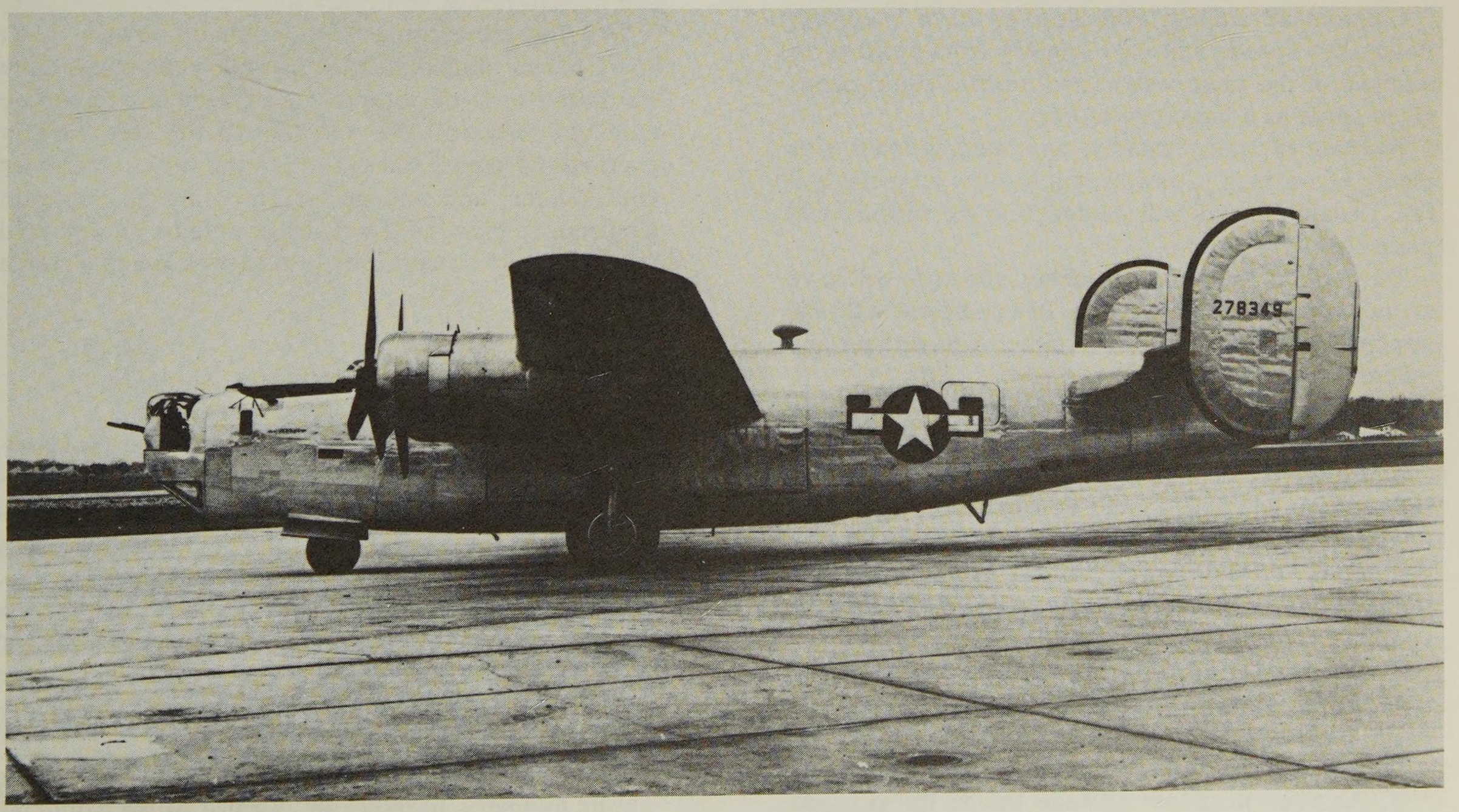
Maximum gross weight of 56,000 lbs.: do not attempt other than normal flight.

Emergency maximum gross weight of 64,000 lbs.: do not attempt other than normal flight. Operate only from smooth fields and do not exceed cruising speeds until load has been expended to 56,000 lbs. Note: all combat loads exceeded 65,000-66,000 lbs. Then technical orders became only guides; the rule was, naturally, that mission requirements governed behavior. If you could get the airplane to do it, do it.

Stalls

The B-24, the unblooded writer of the flight manual wrote to new transition students, has no unusual stall characteristics. It has sufficient reserves of power; there is no excuse for getting into a stalled condition if the airplane is operated normally.

Exceptions abound. For example, in combat formations at gross weights beyond those in any table, our intrepid pilot must fly at the speed of the lead. Tail-end Charley has to jockey, so if the lead flies at 150 Charley sometimes has to fly faster or slower. Slower? At 66,000 plus? And avoid stalling? The controls are already soft under these conditions. If you start to overrun and have either to reduce power or make an abrupt control movement, you'll note that you are rapidly falling away from your point of reference. You've stalled your bird. You've no choice but to drop your nose and add power. When you get back in formation, curse your element leader roundly at the top of your voice — but without depressing the microphone



A B-24 before it got battle markings.

button. This experience will teach you to fly very smoothly. When you master the technique and can fly for long periods on the edge of a stall, the operations people will move you forward in the formation, thereafter getting their kicks from watching the new troops flounder in the ruck.

Various factors affecting stalling speeds: wheels down will increase the stalling speed of the airplane from 5 to 10 mph. The operation of de-icer boots will have a serious effect on the stalling speed. The degree of cowl-flap opening will reduce airspeed and affect stalling speed accordingly.

A feathered propeller is much less of a drag on the airplane than a windmilling propeller. An engine operating at 11'' of manifold pressure is the equivalent of a feathered propeller.

Comparison of Stalling Speeds

	Gross Weight Lbs.	Wing Flaps and L.G. Retracted IAS	Wing Flaps 40° L.G. Extended IAS
No Power	45,000	110	91
	56,000	123	101
	64,000	132	109
40% Power	45,000	103	71
	56,000	114	80
	64,000	123	85

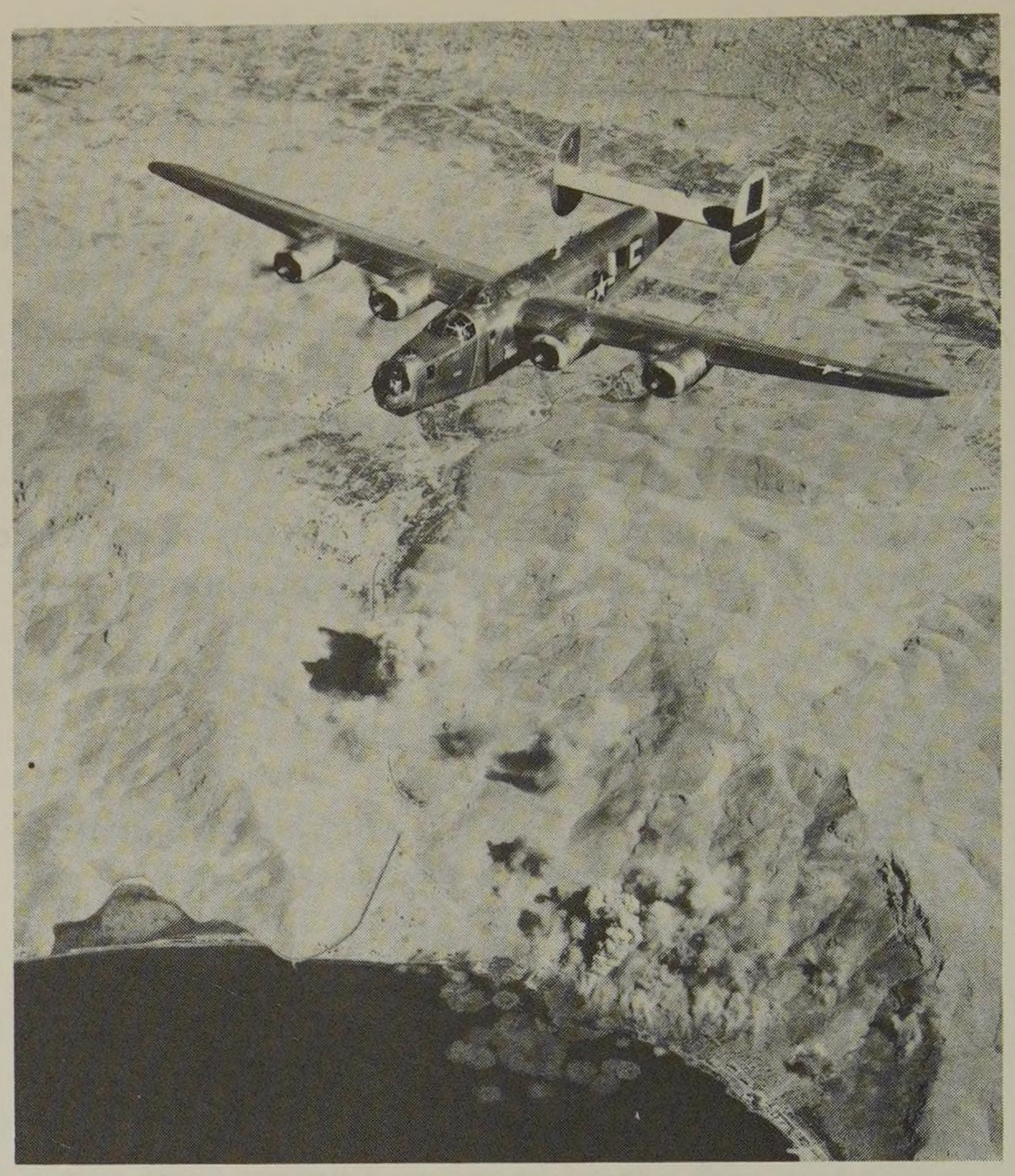
Caution: all stalling speeds given have been test flown, but speeds will vary slightly from airplane to airplane of the same weight and model. Thus speeds given serve as a basic guide only.

Warning of stalls: usually, approaching stalls give plenty of warning. Controls will loosen; airspeed will fall. Usually, the tail will shudder and the airplane will pitch slightly.

The stall: as the stall approaches, the nose will have an increasing tendency to drop. In a complete stall, the airplane will tend to fall off to either side without any inherent tendency to spin.

Recovery from stalls: similar to other airplanes, perhaps easier.

1. Lower the nose to regain flying speed. Note that the airplane will lose a great deal of altitude and pick up speed rapidly.
2. Power-on stall: lower the nose and reduce power immediately to prevent a rolling action caused by torque.
3. If a wing drops and the airplane turns, correct with *rudder*. Don't use ailerons. Ailerons increase the drag, aggravate the stall, and prolong recovery. You can stop the turn and level the wings with rudder alone.
4. As your nose-low attitude builds up airspeed, blend in power gradually.



A B-24 with combat-organization markings.

5. Don't attempt to raise the nose abruptly before you regain speed; a secondary stall can be more violent than the original one.
6. The smooth flyer will blend power and raise the nose to level flight, thus establishing cruising airspeed and normal power settings.

Warning concerning application of power: don't apply power immediately. In a stall, your wings have lost stability; if you abruptly sock on the power, torque may violently roll the airplane to the left, unduly exciting the crew. Always lower the nose, straighten with rudder, and add power smoothly as you gain airspeed. In practice, I was never able to get any wild reactions, and so concluded that I was riding a stable bird.

Turns

Instruments, instruments. Make turns in the Liberator by reference to your little airplane (flight indicator), the directional gyro, the needle-and-ball, altimeter, and airspeed indicator. Secondarily, cross check with the rate-of-climb indicator. One-needle-width turns are normal and will vary in degree of bank from 20 degrees for 150 mph up to 25 degrees for 200 mph. Avoid banks steeper than 45 degrees because of load factor. A 60-degree bank (2 G's) in rough air can easily exceed any loads you'd planned for your day. With steeper banks, load factors rapidly increase to unsafe numbers. In rough air, Airbird Annie would tell you to limit turns to one needle-width and 150 mph.

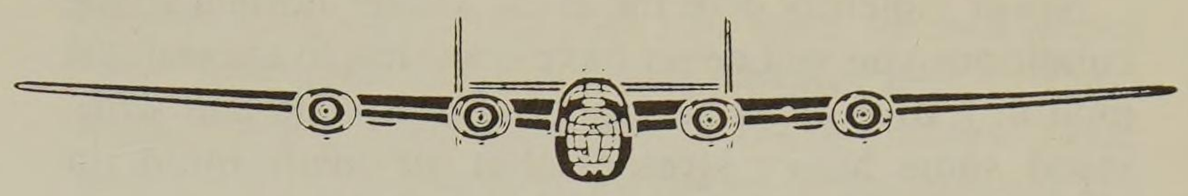
To enter a turn, drop a wing with aileron pressure, coordinating necessary rudder with back pressure on the ailerons. Only slight rudder pressure is necessary. Control resistance is heavy and response is slow. Right here you'll likely remember that it's a man's airplane. Don't stop short of the desired degree of bank and expect the wing to keep dropping. Bring the wing down right to the desired degree of bank and then stop it. You'll have to hold aileron against the bank to keep it from getting steeper. To make your technique smooth, do what the big boys did: practice.

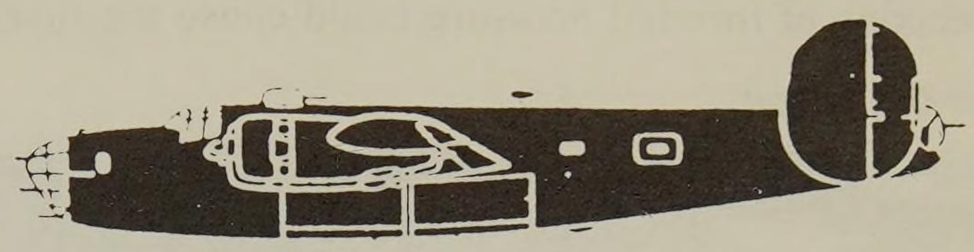
Difference in turns: in a left turn, torque gives the B-24 a slight tendency to lose altitude, so it is necessary to come in early with back pressure to keep the nose level on the horizon. In a right turn, torque causes the airplane to want to climb and the airplane to hold its altitude slightly longer; delay the use of back pressure accordingly. Again, practice helps you hold the bird level in turns.

Rolling out of turns: wing tips are 55 feet away from you; rolling level smoothly takes some time. To roll out of a 30-degree bank, start the roll-out about 15 degrees ahead of the desired heading. Hold in aileron pressure until the flight indicator shows that the wings are level. Proportion of aileron used is much greater than rudder on both entry and recovery. This airplane requires you to eat a good breakfast before doing airwork. Torque, remember, works in opposite directions as you roll out of turns. To keep level, anticipate.

Stalls in turns: no sweat if you maintain your airspeed and fly smoothly. You'll sweat if you let the big mama get ahead of you, lose airspeed and altitude, then correct abruptly.

B-24s overhead, weather observers below. "May you never go afishing when the east wind blows."





How Stalling Speeds Increase in Turns

Gross Weight	Wing Flap Position	30° Bank IAS	60° Bank IAS
43,000 lbs.	0°	115	152
	20°	101	133
	40°	86	113
50,000 lbs.	0°	124	163
	20°	109	143
	40°	93	122
56,000 lbs.	0°	131	173
	20°	115	152
	40°	98	129

Note: Excessive back pressure in any of these turns will cause the stalling speeds to be much higher.

Note: Consider the vertical bank. Lift is zero and airspeed is immaterial. The nose goes straight down and airspeed very rapidly rises past the red line. See my account of any attempt to slow roll the Liberator and the result.

Dives

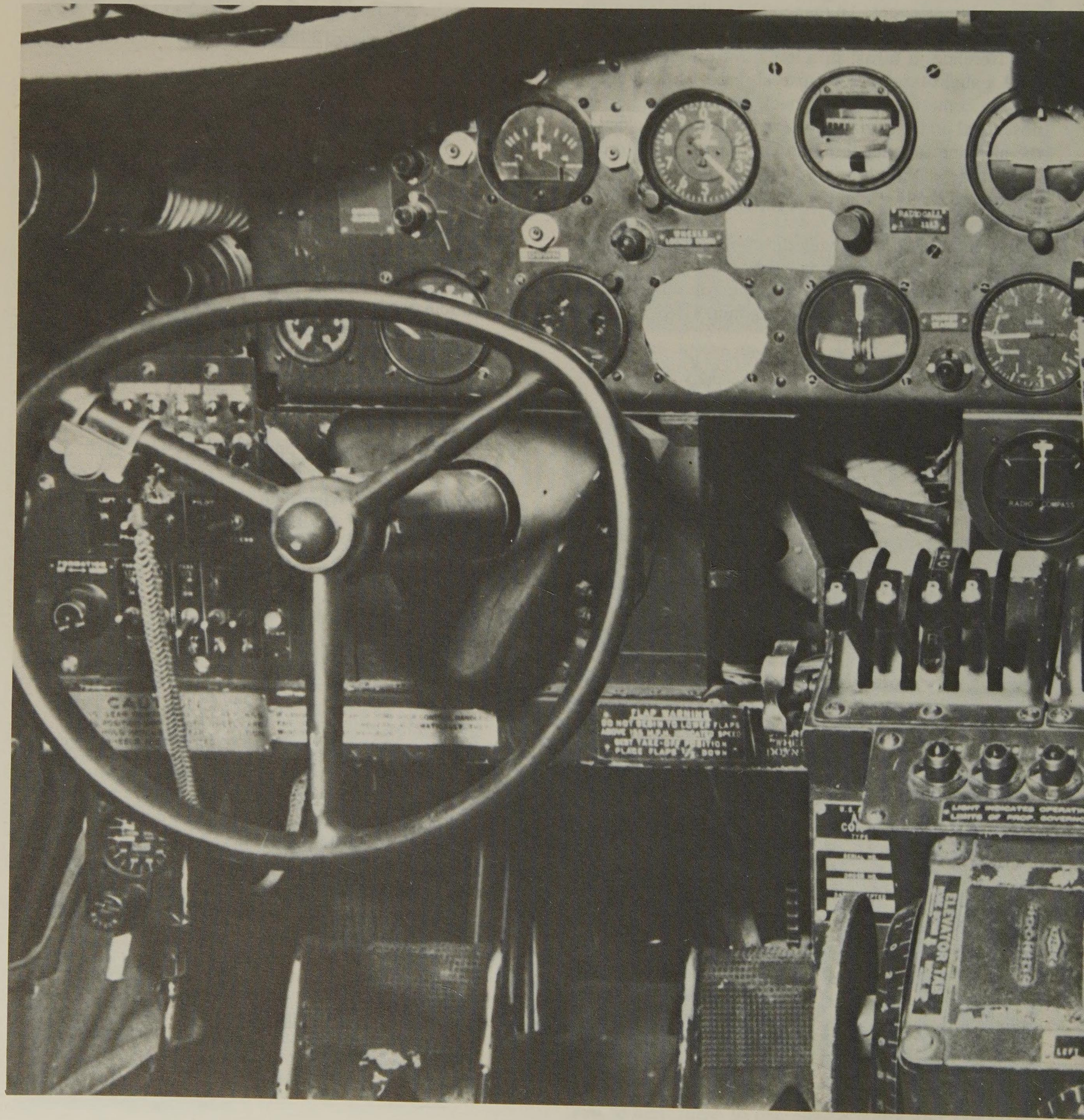
Diving Speed Limits	
41,000 lbs.	355 IAS
47,174 lbs.	325 IAS
56,000 lbs.	275 IAS

Never violently dive the B-24. Under normal flying conditions you will never have occasion to exceed 250 mph in a dive. This strongly built airplane can withstand some heavy stresses, but air loads build up quickly in a large airplane so avoid abrupt movements of controls.

In normal dives, keep the airplane trimmed. Sudden relaxing of forward pressure could cause the fuselage to buckle. Trim nose-heavy rather than tail-heavy. When speeds build up quickly, avoid pulling all the power off; the engines will cool too rapidly.

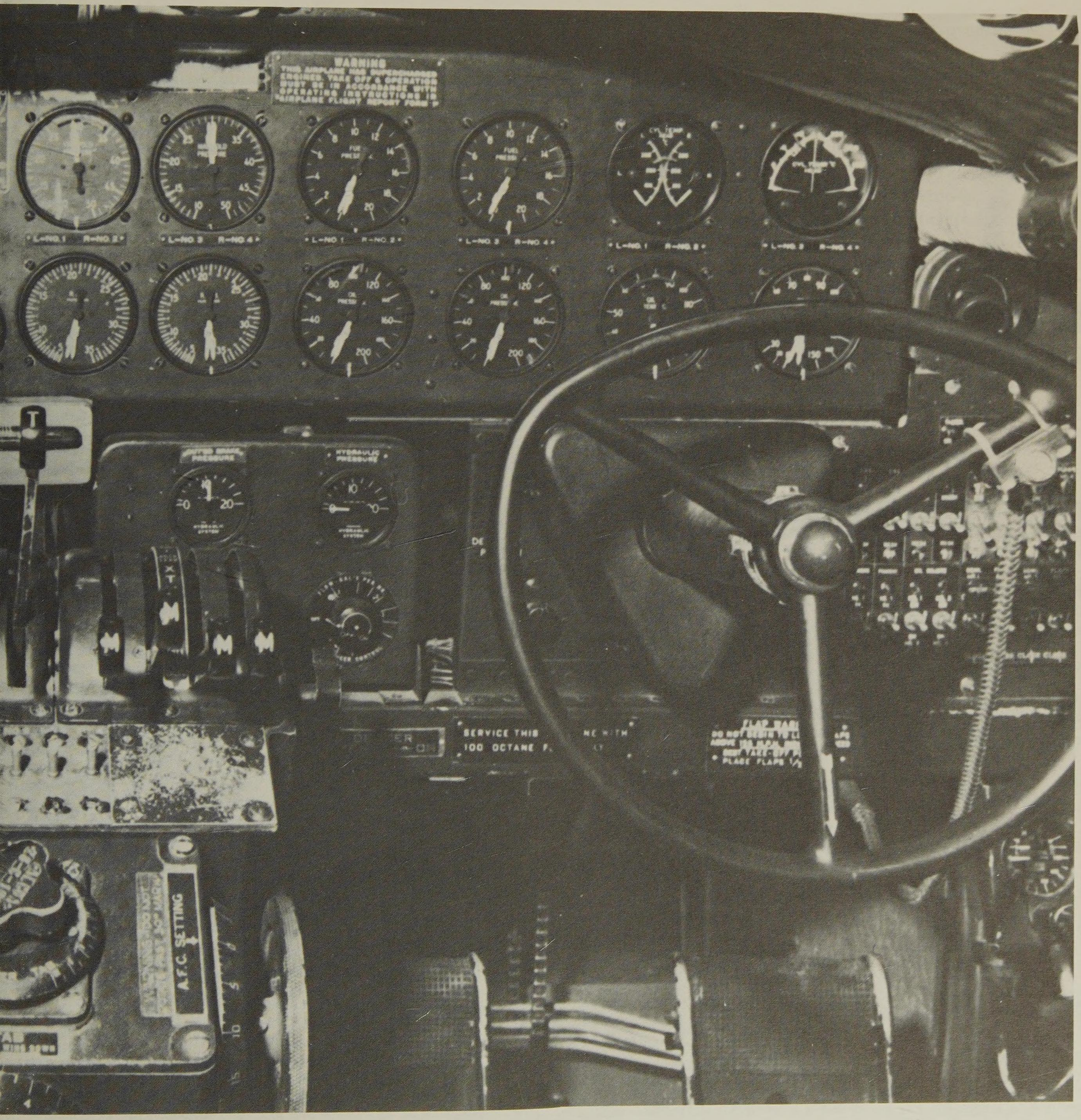
Recovery from dives: recovery from dives requires a lot of altitude. Always recover from dives by manual pressure (if possible) so that you feel the amount of pressure required. Trim tabs can build up excessive strain and cause structural failure of the

B-24D cockpit.



tail — a thing you'll feel sheepish about reporting. When you recover from a high-speed dive, the nose will go up and stay up until the excessive airspeed is dissipated. Level off somewhere near normal cruising speed, trim and set power for level flight, and wait for your heart to come down from way up there where the airplane was.

Combat emergency: suppose your elevator-control cables were shot away and you were thrown into a dive. You could trim it out with elevator tabs — if you work smoothly to avoid excessive pressures. (War Story X-44: I had the rudder-control cables shot out at a place called Linz, Austria. The engineer couldn't splice the cable, so we solved our problem by using the auto-pilot cables, thus proving there are crazy ways to skin a cat.)



45

5
Landings

Now that we have gone from preflight through cruise with the Liberator, we should land it and put it away in the choicest fashion. If we can complete this phase, we can move on to handling the beast when things go wrong, then look at operational considerations. So let's descend.

The B-24 is built for long missions at high altitudes. As with the earlier phases of flight, the skillful descent from altitude requires the careful techniques of the pilot, who obviously must have knowledge of his equipment and must plan its use. Here, planning saves time and fuel, and maintains engine performance. First, consider the distance from the landing field and the desired rate of descent. Try to come down at the rate of 200 feet per minute, using normal cruising power, so as to arrive at the landing-pattern area 500 to 1,000 feet above pattern altitude. Poor planning might bring you over the field far too high, forcing you to chop the power and come down like a lead balloon, keeping you too long in the congested area and cooling your engines too rapidly. Letting down 10,000 feet at 200 feet a minute requires fifty minutes, as your precise navigator will tell you, so start the letdown about an hour out. From 20,000 feet, start one hour and forty minutes out. Lower the nose to establish the rate of descent. Avoid descending at more than 200 mph. Trim to maintain the 200 feet per minute descent. Usually, you'll need to reduce power to maintain a constant airspeed. You aren't a fighter pilot who comes over the field through a high key and descends in circles. You won't likely lose all your power at once.

Reminders

1. Oxygen: stay on oxygen until you get below 10,000 feet.
2. Booster pumps: turn off below 10,000 feet to prevent overheating and to increase their life.
3. Cowl flaps: increased airspeed will lower cylinder-head temperatures, so you should be able to close the cowl flaps.
4. Intercooler shutters: open (but see carburetor icing).
5. Manifold pressure: you may reduce power when descending; in a cruising descent, however, maintain a constant manifold pressure. With manual turbo controls you'll need to advance turbos slightly to maintain manifold pressure while descending until you get to an altitude where internal blowers will provide adequate manifold pressure. Turn turbos all the way off. Now your manifold pressure will rise as you descend, and you can control it by reducing the throttles.

If equipped with electronic turbo controls, manifold pressure will be automatically maintained down to the altitude where internal blowers provide adequate manifold pressure; then manifold pressure rises as altitude decreases, and you'll now control it by reducing throttle settings. Remember to keep about four inches of turbo boost if icing conditions exist.

Don't forget to adhere to air-traffic rules during descent.

Quick descent without excessive airspeed: when you must make a rapid descent, don't just push down the nose and dive; the aerodynamic cleanliness of the B-24 will simply give you redline airspeeds and a reluctance to descend. Try reducing manifold pressure to 18-20 inches and bring the airspeed down to 160 mph before lowering the nose. Hold 160 mph. To increase the rate of descent, reduce manifold pressure. To slow the rate of descent, hold 160 mph and increase manifold pressure. Watch cylinder-head temperatures and prevent excessive cooling.

Cold: in cold weather, you may need to increase rpm to 2400 to keep the engines warm. *Never* make a long power-off descent. This cools the engines too quickly and may result in turbo warping, or in possible engine failure when you resume power.

Approaching the landing area: resume normal power unless you are going directly into the landing pattern.

Strange fields: before clearing into a strange field, you determine that runways are long enough and strong enough for a B-24, that adequate services are available. In somes cases, weather or emergencies may dictate the choice of landing field. Ask the tower to give you needed information about the field, then make your own decision about runway, obstacles in the pattern, and the like. *You, the pilot, make safety decisions. The boy in the tower does not; he offers information, not instructions.* It isn't wise to ignore information from the tower, but you and your crew are the ones at risk.

Sometimes tower operators like to forget this, but the decision and risk are not theirs. So know your airplane and make the safe decisions. Prevailing traffic may force the tower operator to deny a certain request, but only till traffic clears. Then he'll approve your requested deviation. If he doesn't understand the limitation on his authority, be sure to report his ignorance as soon as you are on the ground. He'll behave more cooperatively next time.

Table of distances: think about distances tabled here and fix the order of magnitude involved in doing these things in your steel-trap mind.

LANDING DISTANCE (in feet) B-24, D, E, G, H, & J

Hard Dry Surface

Gross	At Sea Level		At 3000 Feet		At 6000 Feet	
Weight in Lbs.	To Clear 50' Obj.	Ground Roll	To Clear 50' Obj.	Ground Roll	To Clear 50' Obj.	Ground Roll
40,000	2365	1885	2640	2250	2960	2470
50,000	2940	2410	3140	2610	3380	2850

Firm Dry Sod

Gross	At Sea Level		At 3000 Feet		At 6000 Feet	
Weight in Lbs.	To Clear 50' Obj.	Ground Roll	To Clear 50' Obj.	Ground Roll	To Clear 50' Obj.	Ground Roll
40,000	3300	2820	3620	3140	3940	3460
50,000	3920	3490	4240	3700	4560	4040

For ground temperatures above 35°C (95°F) increase approach IAS 10% and allow 20% increase in ground roll.

Comparison: it requires 500 to 600 feet more ground run at a 6000-foot field to land the same weight airplane on the same kind of surface. And you may need as much as 1200 feet more ground roll on sod than on concrete. A difference of 10,000 pounds in weight alone can increase your ground roll by 400 to 600 feet. These average figures, based on no wind, vary with wind and air density. So consider every factor before landing at a strange field.

Caution: the fact that a B-24 got into a certain field last week doesn't mean that you can do it today. Different weight? Different wind? Different air density? One significant variation can add hundreds of feet to the distance required today.

Heads up: Don't get mesmerized by your instruments and the repeated admonitions that the B-24 is an instrument airplane. Around a landing field especially, you must clear yourself. Don't fly into another airplane, thus making your girlfriend and others weep.

Landing checks and techniques:

Before he appointed an important commander to a critical task, Napoleon asked, "Is he lucky?" You can get that reputation if you prepare for situations. Then when you execute well, people will say you are lucky. Study the technical orders. Practice good techniques. Serve the god of airspeed. Here your friendly flight manual cautions you to do everything with power, for the B-24 flies like a lead balloon without power.

Location of downwind leg: set downwind leg 1 to 3 miles out from and parallel to landing runway. Conform to other traffic if there is any. Fly a reciprocal gyro heading. Crosswinds that blow you away from the runway suggest the downwind leg closer to the runway, and of course the reverse is true. With practice you'll be better at perceiving this drift.

Before-landing check: reduce your indicated airspeed to 155 mph as you enter traffic. Start your before-landing checklist early enough to complete it by the time you are opposite the tower on your downwind leg. Note that the checklist items are read out by the copilot as questions, as before, and the appropriate crew member takes the required action and reports it before the copilot calls the next entry on the checklist.

(Asterisks: items with asterisks are checked for all landings, such as touch and go. Items without asterisks need not be checked on subsequent landings.)

1. Copilot: Altimeter setting?

Before entering traffic, copilot calls the tower for altimeter setting and landing instructions.

Pilot: Altimeter set and landing instructions received.

*2. Copilot: Crew to stations?

Engineer checks to see that nose cone section is clear of passengers and crew, also directing that ball turret and trailing antenna be retracted.

Engineer: Crew in landing positions.

*3. Copilot: Auxiliary hydraulic pump?

Engineer turns it on and signals "On." He continues back to the waist to check the main gear down and locked when it comes down.

*4. Copilot: Brake pressure and parking brake?

Pilot presses pedals, notes pressure, and checks parking-brake handle in Off position. Inboard- and outboard-pressure gauges show the same readings as in the preflight check — 975 to 1180 lbs.

Pilot: Brake pressures checked and parking brake off.

5. Copilot: Automatic pilot?

Pilot checks all switches off.

Pilot: All switches off.

*6. Copilot: Gear handle?

Copilot, at the pilot's command "Gear Down," puts the gear handle down at a speed of no greater than 155 mph. When the gear comes down, it will reduce the plane's airspeed by about 5 mph.

Copilot: Gear handle down. (Confirming checks follow in item 13 below.)

*7. Copilot: Mixtures?

At direction of the pilot, copilot puts mixture controls in Auto-rich positions.

Copilot: Mixtures in Auto-rich.

*8. Copilot: Propellers?

When the pilot asks for 2400 rpm on propellers, copilot moves control to 2400 to provide greater flexibility in power available.

Copilot: 2400 rpm.

Increase in rpm will reduce manifold pressure, which the pilot will increase to maintain power.

9. Copilot: Intercoolers?

Copilot checks them open.

Copilot: Intercoolers open.

*10. Copilot: Cowl flaps?

Copilot checks them for required position (based on cylinder head temps).

Copilot: Cowl flaps closed (or as required).

*11. Copilot: Booster pumps?

Copilot turns them all on to assure adequate fuel pressure during landing.

Copilot: Booster pumps on.

12. Copilot: Wing de-icers?

Copilot checks to make sure they are off. Remember the *never* instructions. Never land with wing de-icers on (unless they are exhaust heat units).

Copilot: Wing de-icers off.

*13. Copilot: Wheels?

Pilot and copilot look out to see if they each have a wheel down. Pilot: Wheel left. Copilot: Wheel right. Pilot checks and reports, ''Lights on; handle neutral.''

Engineer: Gear down and locked.

Warning: on final approach, when throttles are retarded to 15'' manifold pressure or less, the horn will blow to warn you if the gear is not fully down or not locked. *Except*, some later model ships do not have horns.

14. Copilot: Ball turret and trailing antenna?

When the engineer has checked the main gear down through the waist windows, he checks to be sure the ball turret and trailing antenna are retracted. Then he goes forward to the nose to check the nose gear down and locked.

Note: in early days retraction of the trailing antenna was not on some checklists, possibly on the thinking that since the radio operator used it, he should retract it. Thus this trailing wire some 350 feet long and having a heavy lead ball at its end was left down and broken off. Added to the pilot's checklist, the daily loss of such antennae ceased.

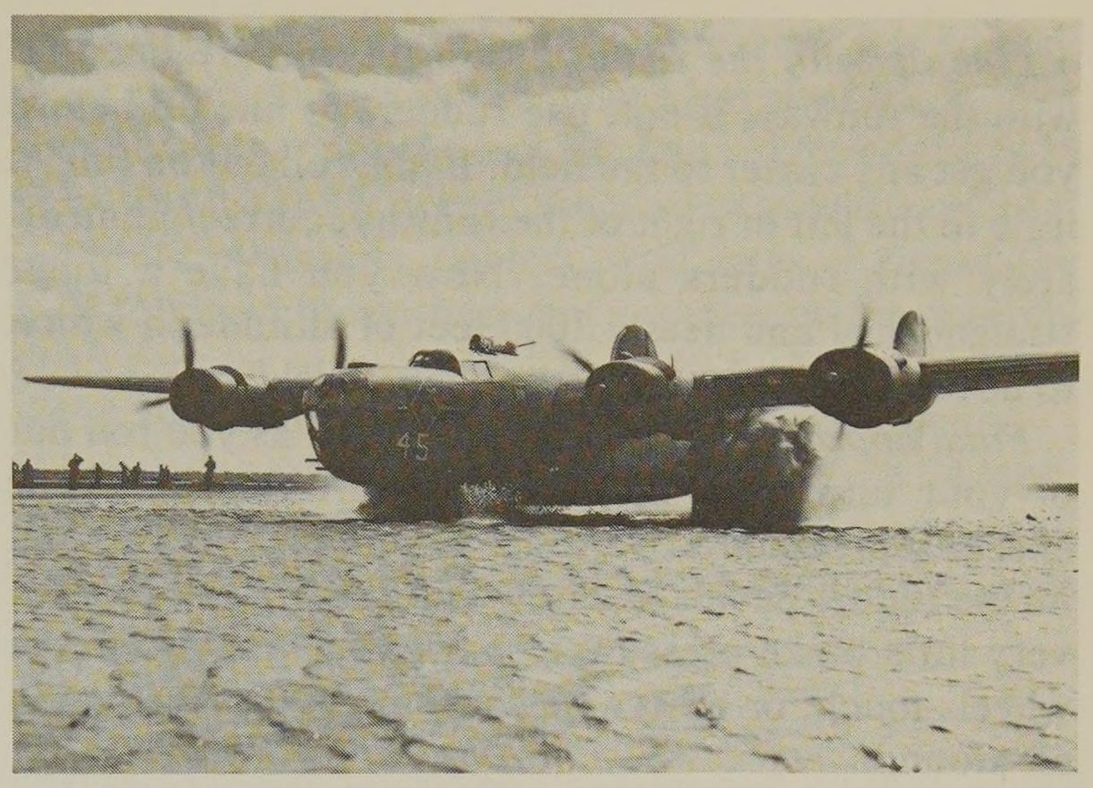
Engineer: Ball turret and trailing antenna retracted.

*15. Copilot: Wing flaps?

At the pilot's direction and at an airspeed of 155 mph or less, the copilot lowers the wing flaps 10 degrees. Lift increases materially here, giving the plane a more level attitude and lowering the stalling speed — and safety observation in traffic is better.

Copilot: 10 degrees of flaps.

Having completed the before-landing check on the downwind leg, you are free to make a good pattern.



B-24D taxying in water.

Get on the step: get on the step just as soon as your wing flaps are down 10 degrees. I repeat an old useful rule: control airspeed with attitude; control altitude with power. If airspeed drops, drop the nose to get desired airspeed. To regain any lost altitude, add power to regain it. Try not to chase airspeed and altitude. If you have lost airspeed, coordinate dropping the nose and adding power to regain altitude and airspeed.

Time your distance out: you are flying a reciprocal gyro heading parallel to the landing runway. As you pass a point opposite to the end of the runway, start timing, usually for thirty to fifty seconds, then start turning at a standard rate (one needle-width) to the base leg. At an average wind velocity, this will carry you about ¾ mile farther out from the end of the runway, putting your base leg perhaps 2¾ mi. out from the field. Control your turns altogether by instruments, timing the turn to the base leg to roll out 90 degrees from the landing runway.

Base leg: if wind is average, which is to say low enough not to be a primary factor in flying your landing pattern, and you have followed good procedures, fly your base leg by gyro heading, observe traffic and look over your approach to the runway, making a judgment about distant out and its relation to altitude. Wise men say the quality of the landing depends largely on making a good entry to the final approach. Not everything, I think, but good advice.

Turning on final approach: when to start your turn to final approach is important, for the common tendency is to wait too long. Lead your standard-rate turn approximately ¾ of a mile. Thus your rollout will bring you onto final approach in line with the runway.

Half flaps: pilot calls for half flaps just as he starts his turn to final approach, and copilot lowers them to 20 degrees.

Power reductions: as the flaps come down, pilot reduces his power to 25'' manifold pressure. Pilot should hold a level turn until 20 degrees of flaps and reduced power bring airspeed down to 135 mph.

Line up with the runway: be sure you are lined up with the runway; if not, use rudders to line up before you get any closer to the field. If you roll out on final a little to the left or right of the runway, correct immediately with rudders alone. Now you have a long, straight final and nearly 1000 feet of altitude in which to accomplish your final-approach checklist.

Final approach (amplified checklist): as you roll out of your turn lined up with the runway, start your checklist procedure. Warning: be sure your feet are flat on the rudder pedals and down off the brakes. It takes very little brake pressure to blow your tires when the wheels touch, or otherwise cause great dissatisfaction all around.

1. Copilot: Propellers?

Pilot has reduced power below 25'' manifold pressure and now calls for high rpm. Copilot sets propellers to full-high rpm.

Copilot: High rpm.

2. Copilot: Superchargers?

Pilot sets superchargers at takeoff manifold pressure so that full power will be available if needed.

3. Copilot: Full flaps?

Pilot calls for full flaps (135 mph) and copilot lowers them, which lowers the airspeed to 125 mph for the remainder of the approach.

Copilot: Full flaps down.

4. Copilot: Airspeed?

Copilot calls out airspeed every few seconds throughout landing to assist pilot in maintaining proper attitude.

Variation: many pilots designated the flight engineer to call out airspeeds on final approach. Standing between the pilots, the engineer is more nearly aligned with the airspeed indicator and can make the calls precisely.

Make good a point: pick a point about 100 feet short of the end of the runway and line it up with a rivet or reference point on the nose. You are making good this point in your descent if you keep it lined up with the reference point on the airplane. If the point on the ground drops below your reference line, you are overshooting it; if the point moves above the reference line, you are undershooting it. Don't try to judge your flight path by a projection of your longitudinal axis.

Airspeed: maintain 125 mph in your glide. With full flaps down you can control your descent with power. A good rate of descent is 500 feet a minute at 15'' to 18'' of manifold pressure. If undershooting, increase power to reduce your rate of descent; if overshooting, decrease power to increase your rate of descent. In either case, maintain a constant approach airspeed.

Flareout: start your flareout high enough — about 150 feet up. It takes time to change the direction of a heavy bird — inertia, the physicists say. Your airspeed will decrease gradually as you gradually raise the nose and reduce power.

Coordination of power and attitude: your flareout and reduction of power should be perfectly coordinated. If you are too high, reduce power; don't steepen your gliding angle and build up excessive airspeed. If you are coming in just right, power should be blended off in coordination with your roundout. If you are flaring out short, let your power reduction lag behind your flareout to carry you farther in; if you are too high, pull power off a little faster to ease you down faster. Properly executed, the flareout will bring the airplane in just above the runway surface at 105 to 110 mph in a definitely nose-up attitude, sinking at a rate that will grease it onto the runway. Power keeps down your rate of descent and keeps the airplane from hitting the runway with a heavy jolt.

Over there near operations, your squadron commander sees a couple of puffs of smoke and hears a kissing sound as your tires touch the runway; pleased, he looks at your aircraft number on his clipboard.

Errors you'll avoid:

Undershooting: there is a tendency to undershoot because in a normal landing the flight path is much steeper than it seems. Pick a reference point by which to judge your glide path; serve the god of airspeed to make good your path to the reference point.

Dropping in: with all power off, the B-24 glides almost straight down. Don't chop off all the power until your wheels are on the runway. As you flare out just off the runway, reduce power smoothly and gradually. With all the drag set up in landing configuration, you'll drop it in if you suddenly chop off all power.

Flying onto the concrete: control the bird with power all the way. Don't drop the nose or you'll pick up airspeed, maybe enough to bounce and fall back in from several feet. *They cheer* at any mistake anywhere in this critical phase. Nose up and airspeed down during flareout; control your sink with power. Use correct airspeed, attitude, and power control, and you'll get a good landing.

Landing roll:

Hold the nose up with the elevators and control direction with the rudders. In a nose-high attitude the drag of the wings and flaps reduces speed rapidly.

Keep the nose high as long as you can with elevators. As speed dies to 75 to 70 mph, the nose will drop. Use a lot of back pressure here to ease the nosewheel gently onto the runway. When the nosewheel is firmly on the ground, raise your feet into braking position — but don't brake yet.

Brakes: as the airspeed slows, feel the brakes gently — gently, remembering that nosewheel strut is right under you. (On my first B-24 landing my instructor foolishly said, ''Feel the brakes.'' I used to work in Chicago, as the ribald song went. To make it short, we survived, but the dipping of that nose made my friendly

instructor old before his time. Much later he added quietly, "I meant to add *Gently*, confound it.") To resume, feel the brakes gently so you'll know what you'll get when you need brakes. Get the airplane slowed down with room to spare, using brakes progressively. Apply them and release them; don't apply them and hold them on — otherwise it's goodbye expander tubes, and no brakes here will surely make them cheer.

Clear the runway: promptly. Can't you feel that clown behind you? His technique is not as good as yours, so let him do whatever he pleases with all the runway.

End of landing roll:

1. Copilot: Superchargers?
   Pilot turns them off while taxying.
   Pilot: Superchargers off.
2. Copilot: Booster pumps?
   At pilot's direction, copilot turns them off.
   Copilot: Booster pumps off.
3. Copilot: Generators?
   Engineer checks them in off position.
   Engineer: Generators off.
4. Copilot: Wing flaps?
   Copilot raises flaps on instructions from the pilot.
   Copilot: Wing flaps up.
5. Copilot: Cowl flaps?
   Copilot opens them fully.
   Copilot: Cowl flaps open.
6. Copilot: Auxiliary power unit?
   Engineer goes forward and starts the APU during taxying, since he had already turned the generators off; generators will not charge batteries when engines produce less than 1700 rpm.
   Engineer: Auxiliary power unit on.
7. Copilot: Brake pressure?
   Copilot checks brake-pressure gauge and continues to check it frequently until the airplane is parked. If at any time the brake-pressure reading falls below 800 psi, pilot will bring the airplane to a stop and not move it again until brake pressure is back up to normal; otherwise, wait for a tow.

Taxying in: as soon as your landing roll is completed, clear the runway and keep taxying. Don't block following traffic. At strange fields, ask the tower for taxying advice. Tower personnel are there to help you. Ask for clearance before crossing runways.

Commentary on landings:

My first landing in a B-24 was a good one, as was my second, third and so on. I had some good reading in the tech orders and had some good examples. I found the Liberator easy to land; I even began to believe I couldn't make a bad landing in it. After all that hard pulling and pushing across the sky, I found quite a surprise at the easy landings I always made. Bad landings can be made, but why make one when it is so easy to, as they say, grease it in. I have bounced the B-17 in sometimes, but never the B-24. Later, I found the B-25 to be like the B-24, except the work was taken out of it (controls pleasantly lighter). Still later, I found the B-26 followed the pattern, but so sweet on the controls as to capture your heart. The B-29 looked something like a B-17 but handled like a B-24 in many ways.

Special problems can arise to complicate B-24 landings, however, and as soon as we can park the bird and bed her down, we'll take up minor problems, then look at some emergencies.

Parking the airplane:

I always felt great after completing a mission and making a good landing. Then I had nothing to do except taxi slowly in and park. If you too feel good after that grease job, now try some good technique to display to the audience: taxying, shutting down, bedding down the airplane, taking care of the crew, and — playing the good cavalryman — at last taking care of yourself. So easy does it, but don't get careless yet.

Wait for directions if not familiar with the field. Get a ground crewman out in front to guide you and a wing walker on each side. They can be a lot of help, but you as the intrepid pilot are responsible for the bird. If inexperienced wing walkers don't clear you, if they cause a taxi accident, it is *your* fault. If you aren't certain about clearance, stop the airplane right there and have the ground crew put the airplane away with a tug. You can't see your wingtips when the airplane is on the ground. You will learn offset devices to tell you where your wingtip is, but don't bet your airplane and your wings on some indirect guide. When you get to your parking place or hardstand and turn if necessary to your parking spot, taxi a very short distance straight ahead to make sure your nose wheel is straight before you set the parking brakes.

Caution: when the airplane is stopped, keep your well-disciplined crew and well-briefed passengers in the plane until you shut down the engines and the propellers have stopped turning — too many horror stories of what undisciplined people did at this dangerous point float around the hangars of the world. To follow this caution add an obvious one: never let anyone walk through the propellers at any time.

Use the checklist again to secure the airplane:

1. Copilot: Engines?
   Pilot opens the throttles until the propellers reach 1000 rpm. Copilot puts mixture controls in Idle cut-off; then pilot opens throttles slowly as engines die and leaves throttles fully open.
   Copilot: Mixtures in Idle cut-off.
   Pilot: Throttles fully open.
2. Copilot: Switches?
   Copilot shuts off all switches after propellers have stopped, first magnetos and radio, then, when autosyn

instruments such as oil, fuel, etc., have returned to neutral, he turns off AC power, lights, battery selectors, and main line. Don't cut battery selectors and main line until all electrical switches are off.

Copilot: Switches off.

(Now at night you are in total darkness. The pilot reaches into the knee pocket of his flying suit and draws his trusty, fresh-batteried, two-celled, olive-drab flashlight and points its bright beam at the knee pocket of the copilot's flying suit, reminding him that he too has such a piece of issue equipment, even though he has bought his own batteries at the exchange. The flight engineer has a still better issue flashlight. Stories, here again, echo through many an abandoned hangar about the flight engineer's flashlight that saved everything.)

3. Copilot: wheel chocks?

Pilot checks left wheel chock and copilot checks right wheel chock in place so brakes may be released, because heat continues to expand the expander tubes. Brakes should be left unlocked until they cool off; later the crew chief may set them again.

Pilot: Wheel chock in place left.

Copilot: Wheel chock in place right.

Pilot now releases brakes and reports to crewmen outside, Brakes off.

4. Copilot: Gear handle?

Copilot puts landing-gear handle in the down position so that any hydraulic expansion will tend to close the gear lock rather than to open it.

Copilot: Gear handle down.

5. Copilot: Flight controls?

Copilot locks flight controls while pilot loosens the locking strap. Use the following sequence for locking controls: first lock rudder by holding controls near neutral and slowly moving either way while applying slight tension to the locking handle until you feel the rudders lock. Next lock the elevators by moving the wheel to the white line on the control column and then slowly back and forth until the locking pin drops in. Lock ailerons by moving wheel slightly from side to side until the aileron pin drops in. Do not force the locking handle. Then place the hook in the handle and draw the strap tight.

Fill out Form 1 and 1A before leaving the airplane and give the engineer full instructions as to servicing.

Parking at strange fields:

Airplane and crew are the airplane commander's responsibility. You can delegate duties but you cannot delegate responsibility. You must arrange for proper servicing, securing, and mooring of the airplane. The airplane should be locked and a guard should be posted if there is no regular guard position, even if you have to hire a civil guard. The government, which is to say those sitters in finance, will surely try to make you personally pay for that guard.

Think of your crew's comfort before you think of your own. See that they have a place to sleep and eat; check transportation; arrange for passes to get them in and out of the field, and notify them of planned takeoff time so they will know when to have the airplane ready. You take care of them and they will take care of you. Now you can stumble off to the club or the visiting quarters, or even to the nearest lively singles bar.

Techniques for other-than-routine conditions:

The flight we just went through assumed normal, routine conditions. Much of your experience will include situations that call for special techniques. Before looking at emergencies, we should look at some less than heart-stopping situations you'll have to deal with during the critical landing phase.

Crosswind landings: crosswind landings in the B-24 present the same problems as they do in other aircraft, but poor technique can cause more serious results. The object is to put the airplane onto the runway with zero drift and pointed straight along the center line. Any drift on touchdown imposes a heavy slide load on the gear, possibly leading to things you want fervently to avoid — blown tires or collapsed landing gear.

In a crosswind, make a normal landing approach. Line up with the runway and note your drift. The choice, as with all airplanes, is to kill the drift with crab, keeping the wings level, or to lower the upwind wing until there is no drift in the approach. With slight crosswinds, you can skin that cat either way. With more crosswind, you'll need to combine the methods when you get near touchdown. Ideally, you could start earlier on the final to kill drift with a crab and a wing lowered — just so you touch down rolling straight along the runway.

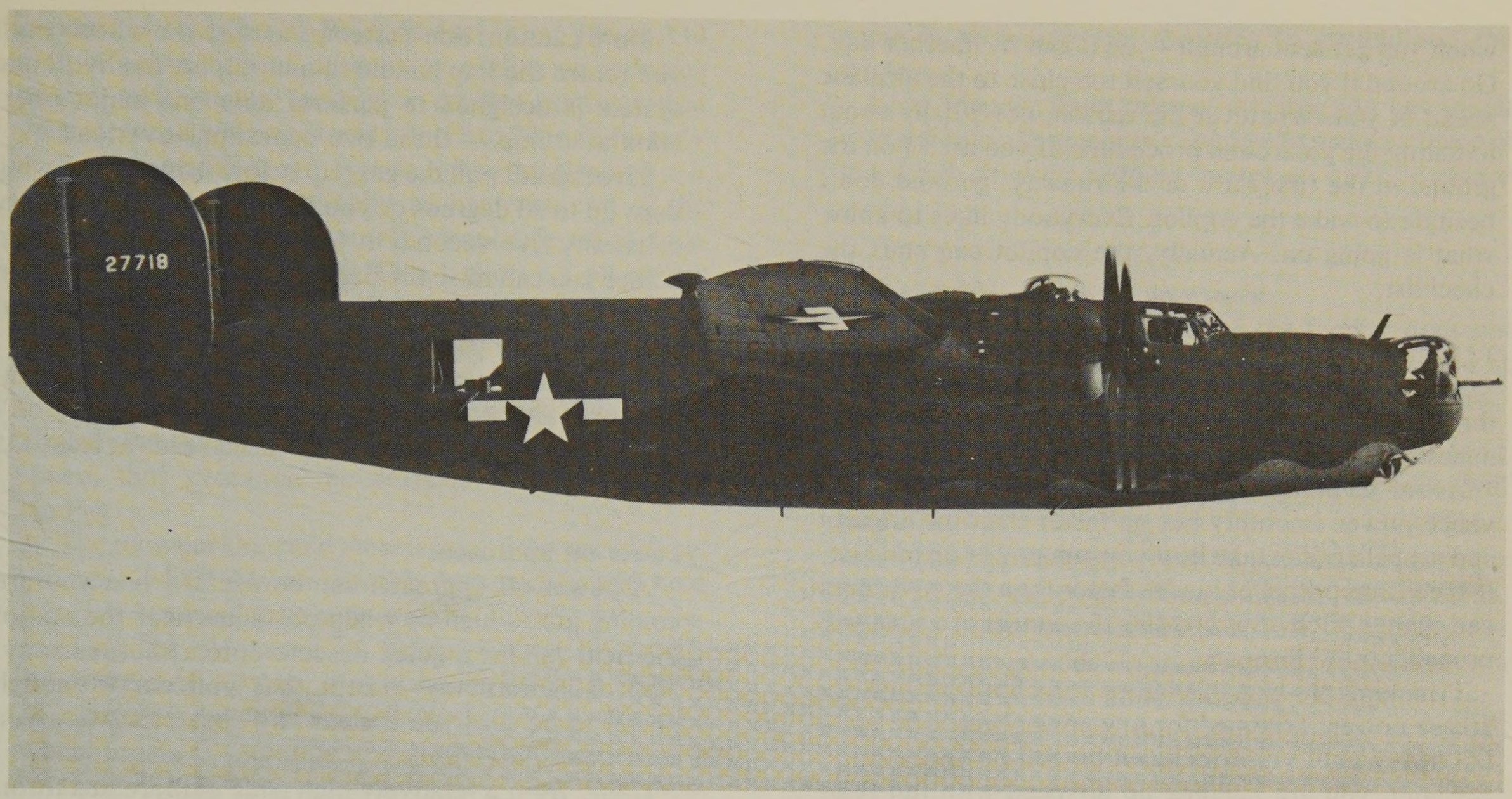
Full crab:

1. Hold the wings level and rudder the airplane sufficiently into the wind to fly a ground track down the center of the runway.

2. As you flare out, rudder the airplane to head the nose down the center of the runway.

3. If you misjudge in a high wind, they will cheer. If you kick out the crab too soon, you'll start to drift again and will hit the ground with all that side stress, for which the B-24 was not designed. If you don't kick out the crab in time, you will, again, land with all that side stress on the gear. Kicking out the crab the instant before touchdown is a matter of good depth perception and good judgment. Perfect timing plays the critical role because of the large correction necessary and the slow rate of rudder response at landing airspeed.

Combination method: to correct drift in a strong crosswind, crab and drop the upwind wing slightly to make a good track in line with the



B-24 in flight.

runway. You rudder into the crab and lower the wing in a coordinated movement; at the same time, lower the nose slightly and relax rudder pressure. The result is a crab and a mild slip into the wind. Be careful not to drop the wing too much, for you lose altitude rapidly in an uncoordinated bank.

Achtung: be sure your airplane is not drifting as you touch the runway. Usually you can correct the crab and lift the wing almost entirely by rudder.

Use no more aileron than necessary — ailerons create burble at low flying speed.

Warning: if you kick out the crab too soon and start drifting, save it by doing one of these: 1. Apply power to keep the airplane from touching mother earth and reestablish a non-drifting line of flight. 2. If the first won't work, apply the power and go around. Then try again. Just don't hit the ground going sideways.

The combination crosswind-landing approach is most common. In any case, practice the approaches and landings. If you get a VIP in the right seat sometime, you'll be ready to impress him.

Crosswind landing roll: whatever method you use for landing, you might note that the best of flyers touch down with the nose slightly lower than normal but with the nose wheel definitely clear of the runway. Bring the nose wheel firmly down as soon as you can. The tricycle gear, inherently stable, overcomes the weathervaning effect of the crosswind on the airplane, for the center of gravity is between the main gear and the nose gear. Inertia is straight ahead and tends to pull the nose wheel back to the center line if it starts to veer. With conventional gear and the center of gravity aft of the main gear, inertia tends to swing the tail around and aggravate the groundloop tendency.

Hold the B-24 straight ahead with rudder control until the speed slows to 75 or 70 mph. As you lose rudder control, a little throttle on the upwind outboard engine will hold the bird straight. In extreme wind, a touch of brake on the downwind side can help. Watch it. Don't get that brake hot. *They're* waiting to cheer. And don't relax until the airplane is parked.

Crosswind taxying: a high crosswind makes it difficult to hold neutral rudder. Save some bitter curses by locking the controls. But unlock them again before another takeoff. In a slighter crosswind, the copilot can usually hold the controls neutral.

But in any case, taxying in crosswind is less than pure fun, so you must become clever with the upwind throttle, leading with it to avoid turning into the wind, easing it back to straighten out. You'll frequently get slight S-turns this way, but practice will largely straighten them out. If you set a constantly higher power on the upwind engine, watch your taxi speed to keep from crushing the colonel's flock of pheasants, thus causing a bloody taxiway.

Go-around:

Don't be ashamed to go around; it's better than mashing up your day. And it won't often be a good pilot's fault. For God's sake don't argue with the tower

when you get sent around — do it and fly another day. Go around if you find yourself too close to the airplane ahead of you. Whatever the reason, don't dally about initiating the go-around procedure. If you aren't on the ground in the first third of the runway, go; and don't hesitate to wake the copilot. Everybody likes to know what is going on. Actually, the copilot can start the checklist.

1. Copilot: Power?

As he announces the go-around, the pilot opens throttles to takeoff manifold pressure and trims as necessary.

Avoid jamming: don't stiff-arm the throttles. Advance power smoothly but no faster than the engines and propellers can take it. If you jam power on too fast, it speeds up propeller blades faster than the governors can change pitch, thus creating the danger of a runaway propeller.

Trimming: re-trim elevators for climb as you increase power. Trimmed for low power, you'll be quite tail heavy until you trim again for full power.

Climb: you are building up airspeed with full flaps down; hold a near level attitude with very shallow climb.

2. Copilot: Airspeed?

Copilot or engineer (as designated by the pilot) calls out the airspeed to the pilot every few seconds

3. Copilot: Wing flaps?

After the airplane has reached a safe airspeed (120 mph or upward) the pilot orders the copilot to bring the flaps up to 20 degrees. When the copilot gets the flaps up to 20 degrees, he returns the flap handle to neutral. Simultaneously, the pilot raises the nose to maintain lift and altitude. Thus the airplane will not sink, and the airspeed will rapidly build up to 135 mph.

Copilot: Wing flaps at 20 degrees.

Be careful: stop at half flaps. Don't get distracted and let the flaps come all the way up. Don't start the flaps up until you have 120 mph indicated airspeed. Don't let the plane sink while flaps are coming up. Raise the nose enough to maintain altitude without reducing airspeed.

4. Copilot: Wheels?

Pilot's handbook reads: "As soon as the flaps are up to 20 degrees, the copilot will reach over and raise the wheels without command from the pilot." — Let's have the pilot make the standard audio visual signal, then the copilot raises the gear handle. (I don't relish the worst scenario, in which some power loss or other emergency causes the pilot to close the throttles and land, thinking he has wheels down, when they are on the way up.) So, the copilot has asked about the wheels; let the pilot say.

Pilot calls "Wheels up," and makes the visual signal by simultaneously raising his right fist, thumb up.

Copilot: Gear coming up.

More caution: don't attempt to raise the wheels until you return the flap handle to neutral, for the hydraulic system is designed to perform only one major operation at a time — these two operations overload it.

Error: don't pull the gear up before bringing the wing flaps up to 20 degrees or you'll have to wait the twenty to twenty-five seconds it takes the gear to come up before you can raise the flaps. Aircraft straining to gain speed and climb against full flaps makes the time seem long enough for you to regret taking up the flying game.

Check: after you have a safe airspeed, check temperatures and set cowl flaps at trail, if necessary. Don't change cowl flaps until your airspeed reads at least 135 mph.

Power-off approach:

A power-off approach can be useful when you are coming in too high or when obstacles near the end of the field call for a quick descent onto a short runway. Approach normally except that you carry enough power to be sure you'll clear any obstacles when you start your glide.

Glide: from a relatively high glide path, retard throttles completely and lower the nose to maintain an airspeed of 125 mph. Without power, the descent is quite steep. Trim to ease elevator pressure, but overtrimming will cause the airplane to have a strong nose-high tendency when you advance the throttles.

Flareout: start flareout at 150 to 100 feet above the runway and at the same time increase throttles to 12"-14" of manifold pressure to stop the rapid descent and change the flight path's direction from down to forward. You have here to overcome the inertia of the heavy airplane, that reluctance to change direction of movement. As you near the runway, reduce power to keep airspeed from increasing beyond 110 mph (more if the aircraft is still heavily loaded). Avoid completely reducing power until you touch the runway. If you completely cut off the power while you are in the air, the airplane doesn't flare out but simply keeps on sinking. Then, with luck, you won't be completely washed out but will be allowed to try again in a less demanding airplane.

Emergency short-field landings:

Go to a normal field unless it is necessary to land on a short field. But if you have an absolute emergency, you can use the technique you learned on a sunnier day. Remind me to tell you of a landing on a Jugoslavian Partisan runway — some other time.

Procedure:

1. Make normal downwind and base legs, carefully looking over your task.
2. Make a normal final approach but aim for a point several hundred feet short of the runway.
3. Flare out as if you were going to land short but add power as you increase your angle of attack so that the

airplane is dragging in 50 or 60 feet up at 105 to 110 mph. Control rate of descent by adding or reducing power. (With heavy loading or combat configuration your airspeed will necessarily be 15 to 20 mph faster.)
4. Reduce manifold pressure to lower the airplane in a nose-high attitude at a point as near the end of the runway as possible. Pull power completely off as soon as you touch the runway. Don't chop off all power before you touch down, for the only thing that is keeping you flying is the thrust from your propellers. Don't make them cheer by allowing airspeed to rise — lowering the nose will increase airspeed, causing the airplane to float and use up runway to dissipate airspeed, thus defeating the purpose of the short-field landing.
5. The moment the main wheels are on the ground, get the nose wheel down smoothly but quickly and hold positive forward pressure on the wheel, fully depressing the oleo strut so braking won't injure the nose-wheel assembly. Since this imposes a risk of excessive strain on the nose wheel, build up forward wheel pressure smoothly and gradually.
6. Immediately feel out the brakes, then use them strongly and intermittently. Never apply brakes continuously unless absolute necessary.

Advantages: this technique brings the airplane to the ground as near the end of the runway as possible, at minimum forward speed, and permits the use of brakes quickly, thus giving you maximum benefit from all the runway.

Errors: if overshooting, go around and come in for another try. If you have slowed down too much to have room to go around, but are running off the end of the runway because the brakes won't stop you, judge quickly on one of these two possible courses of action:

1. As you roll from the end of the runway, get off the brakes and pull as much weight as possible off the nose wheel, which otherwise may dig into soft dirt and collapse.

2. If there are obstructions or a dropoff ahead, the best course may be to bear down hard on one brake and come in with opposite throttles to groundloop the airplane.

Your friendly flight manual advises you not to get yourself into a spot where you have to make a choice of this kind. *Having nothing better to offer, I would agree.*

Low-visibility or close-in approach:

If you don't have a radio, or the facility does not have any directional radio aids, and you must land at *this* field in *this* low visibility, follow this procedure.

1. Approach the field in the direction you are going to land at traffic altitude or as high as visibility will permit.

2. Check in with the tower, if you have a radio, for other traffic, exact conditions, nearby obstructions, and any other instructions available. Complete the checklist, get gear down and checked, and, when you get to the field, have an airspeed of 150 mph.

3. Fly upwind along the landing runway to the opposite end.

4. Lower the flaps to 20 degrees; reduce airspeed to 135-140 mph (if gross weight permits), and execute a one-minute timed turn of 180 degrees.

5. Fly back on the reciprocal heading and at the end of the runway fly out for fifteen seconds.

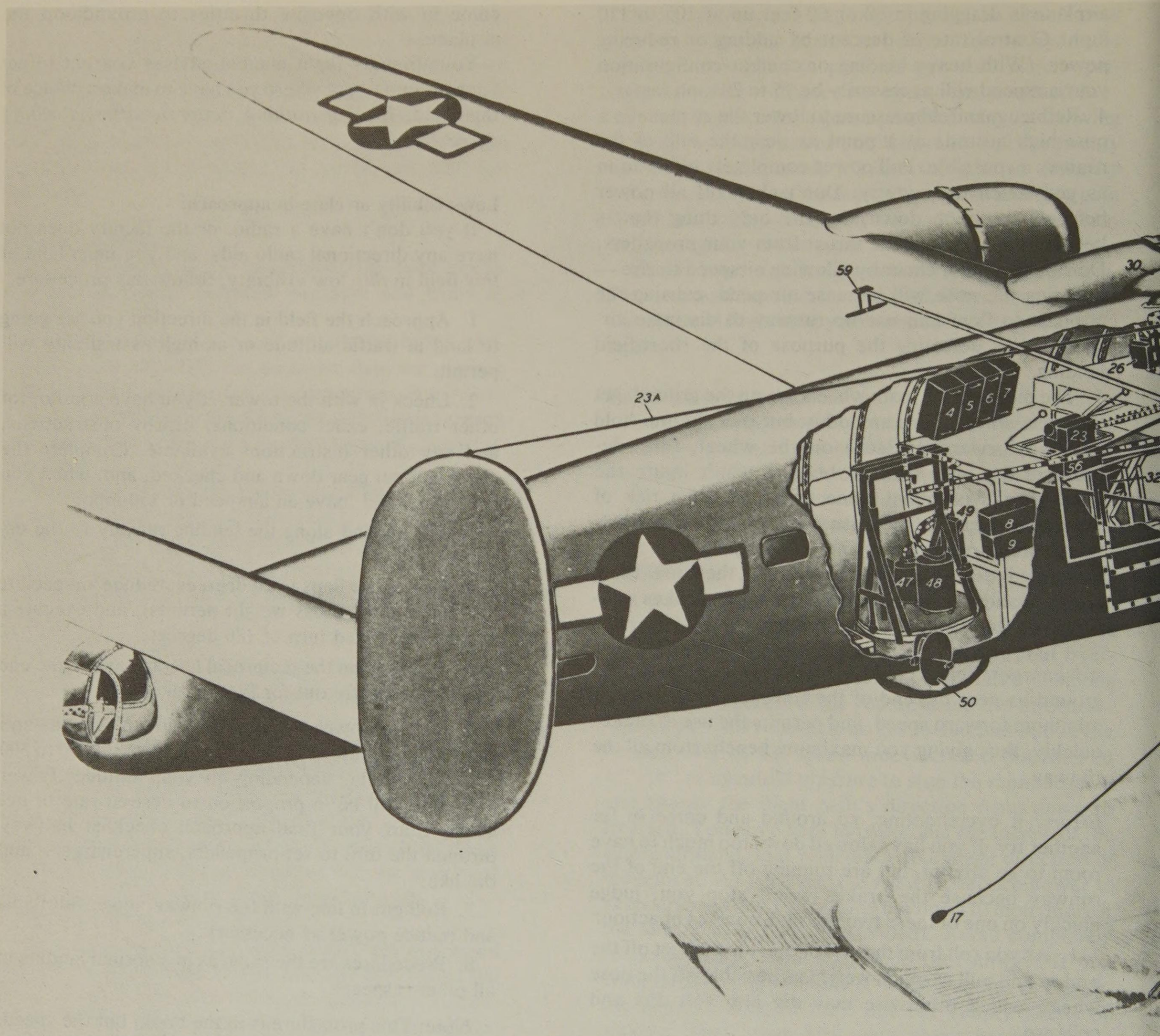
6. Reduce power at the end of fifteen seconds and start a one-minute timed turn, descending at 200 to 500 feet per minute, depending on your altitude. Power reduction will be in proportion to desired rate of descent. Start your final approach checklist halfway through the turn to set propellers, superchargers, and the like.

7. Roll out in line with the runway, lower full flaps, and reduce power as necessary.

8. Procedures are the same as in a normal landing in all other respects.

Note: This procedure is in the book, but the speeds are terrifyingly near stalling speeds. I have heard of no old pilots who used it.

Partial cutaway of B-24 fuselage.



THE FOLLOWING EQUIPMENT INSTALLED IN THE

RADIO SET, SCR-287-( )

1. RADIO RECEIVER; BC-348-( )
2. RADIO TRANSMITTER; BC-385-( )
3. TUNING UNIT; TU-5-( )
4. TUNING UNIT; TU-6-( )
5. TUNING UNIT; TU-7-( )
6. TUNING UNIT; TU-8-( )
7. TUNING UNIT; TU-9-( )
8. TUNING UNIT; TU-10-( )
9. TUNING UNIT; TU-26-( )
10. JUNCTION BOX; AAF EQUIPMENT
11. DYNAMOTOR UNIT; PE-73-( )
12. ANTENNA TUNING UNIT; BC-306-( )
13. REEL CONTROL BOX; BC-461-( )
14. REEL; RL-42-( )
15. FAIRLEAD; F-10-( )
16. WIRE ANTENNA
17. WEIGHT; WT-7-( )

RADIO SET, SCR-274-N

18. RADIO RECEIVERS; BC-453-( ); BC-454-( ); BC-455-( )
19. RADIO TRANSMITTERS; BC-457-( ); BC-458-( )
20. ANTENNA RELAY UNIT; BC-442-( )
21. RADIO CONTROL BOX UNIT; BC-450-( )
22. RADIO CONTROL BOX; BC-451-( )
23. MODULATOR UNIT; BC-456-( )

23A WIRE ANTENNA

RADIO COMPASS, SCR-269-( )

24. RADIO COMPASS UNIT; BC-433-( )
25. JUNCTION BOX; AAF EQUIPMENT
26. RADIO CONTROL BOX; BC-434-( )
27. RADIO CONTROL BOX; BC-434-( )
28. RADIO CONTROL BOX; BC-434-( ) WITH INDICATOR I-82-( )
29. INDICATOR I-82-( )
30. LOOP ANTENNA LP-21-( )

FREQUENCY METER, SCR-211-( )

31. FREQUENCY METER; BC-221-( ) IN BG-81-( )

MARKER BEACON EQUIP, RC-193-( )

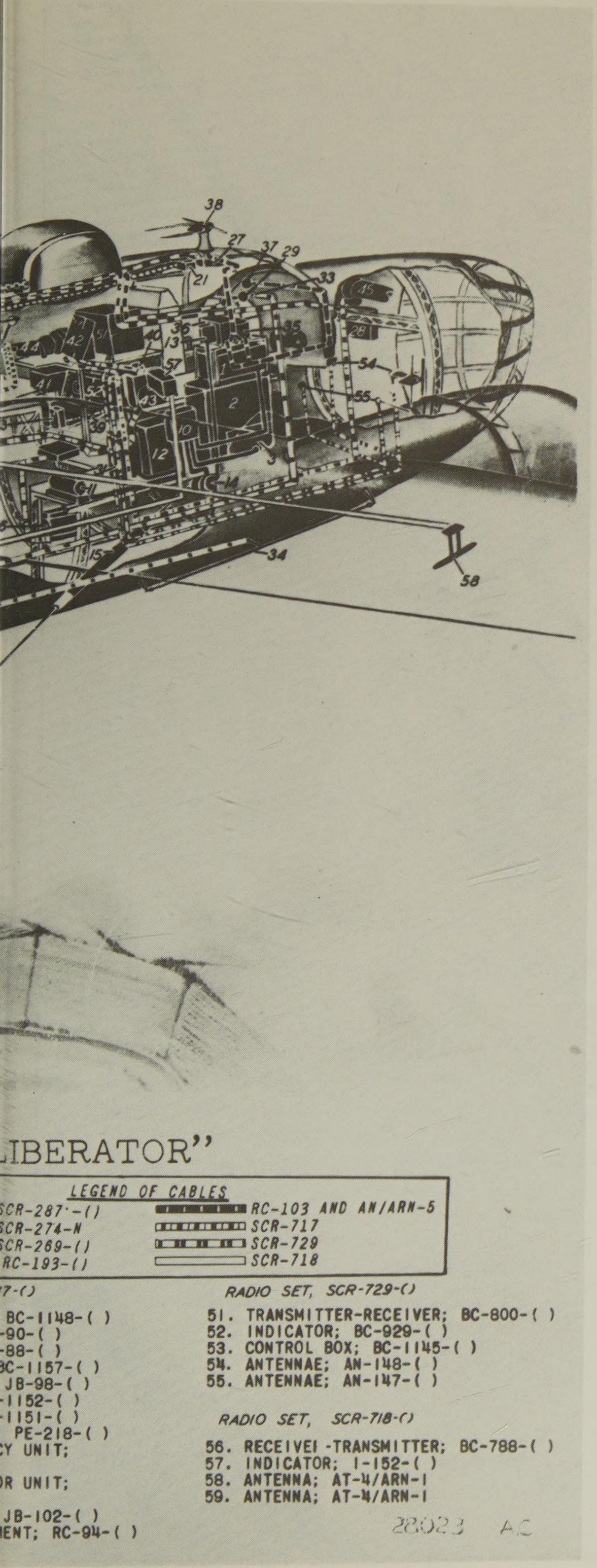
32. MARKER BEACON RECEIVER; BC-1033-( )
33. MARKER BEACON INDICATOR; ID-4/AR
34. WIRE ANTENNA; W-106-( )

LOCALIZER & GLIDE PATH EQUIP. RC-103-( ) + AN/ARN-5

35. GLIDE PATH RECEIVER; BC-948-( ), AN/ARN-5
36. LOCALIZER RECEIVER; BC-733-( ), RC-103-( )
37. LOCALIZER AND GLIDE PATH INDICATOR I-101-( )
38. ANTENNA FOR LOCALIZER AND GLIDE PATH RECEIVERS

R

39.
40.
41.
42.
43.
44.
45.
46.
47.
48.
49.
50.



LIBERATOR"

LEGEND OF CABLES

SCR-287-( )	RC-103 AND AN/ARN-5
SCR-274-N	SCR-717
SCR-269-( )	SCR-729
RC-193-( )	SCR-718

7-( )

BC-1148-( )
-90-( )
-88-( )
BC-1157-( )
JB-98-( )
-1152-( )
-1151-( )
PE-218-( )
CY UNIT;
OR UNIT;
JB-102-( )
IENT; RC-94-( )

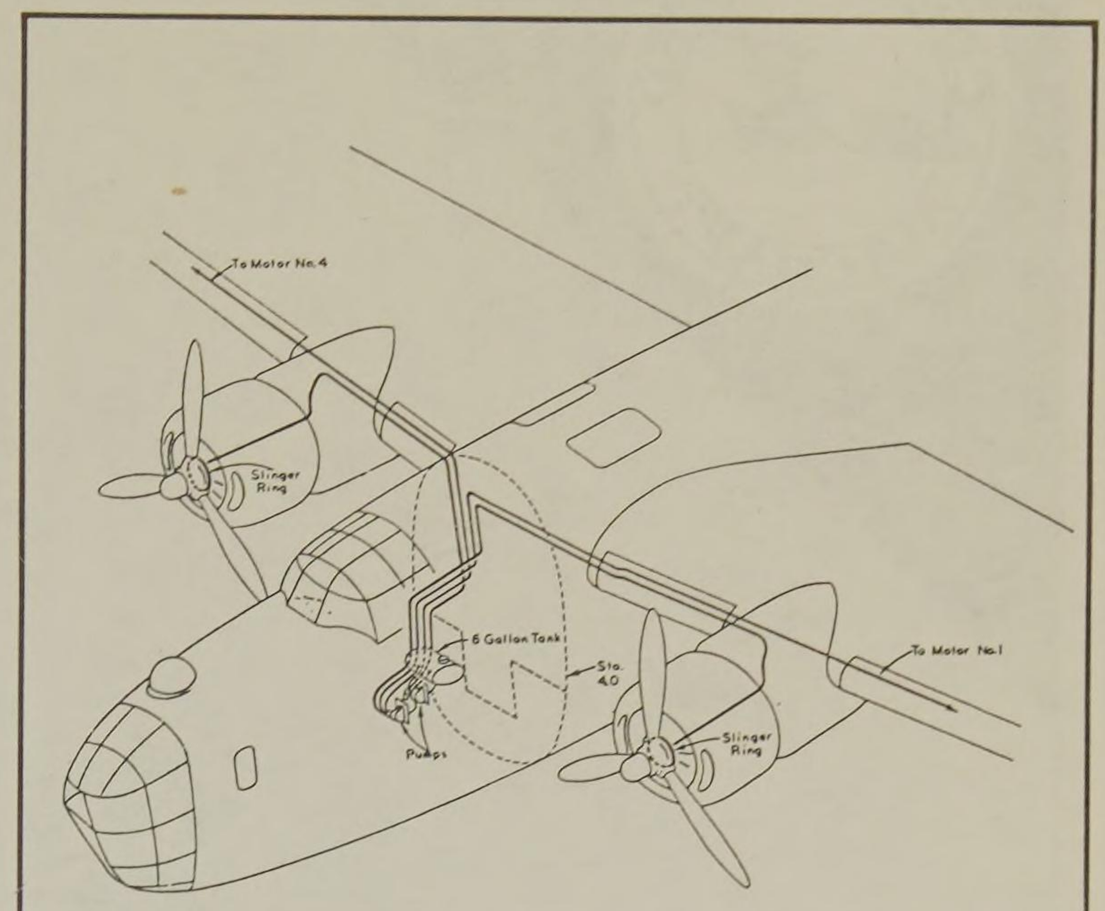
RADIO SET, SCR-729-( )

51. TRANSMITTER-RECEIVER; BC-800-( )
52. INDICATOR; BC-929-( )
53. CONTROL BOX; BC-1145-( )
54. ANTENNAE; AN-148-( )
55. ANTENNAE; AN-147-( )

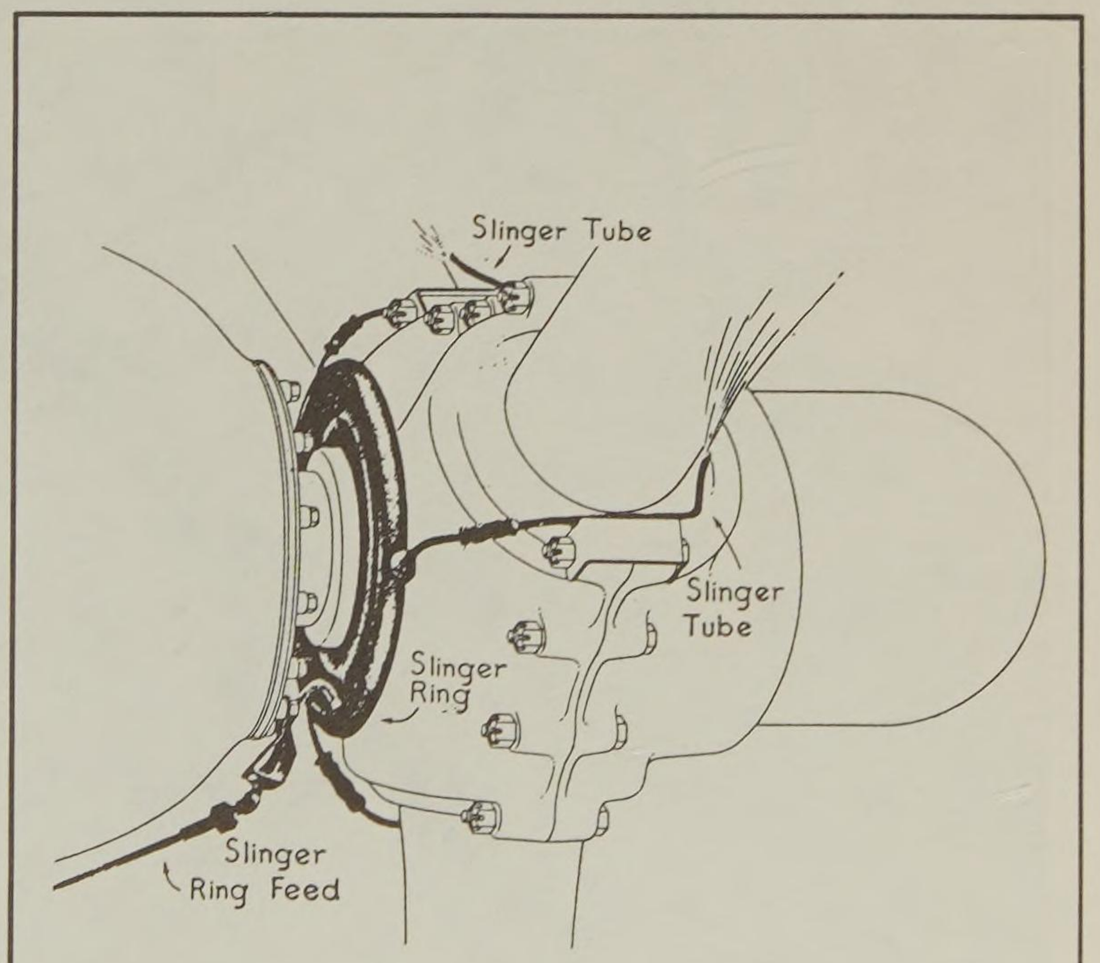
RADIO SET, SCR-718-( )

56. RECEIVEI -TRANSMITTER; BC-788-( )
57. INDICATOR; I-152-( )
58. ANTENNA; AT-4/ARN-1
59. ANTENNA; AT-4/ARN-1

28023 AC

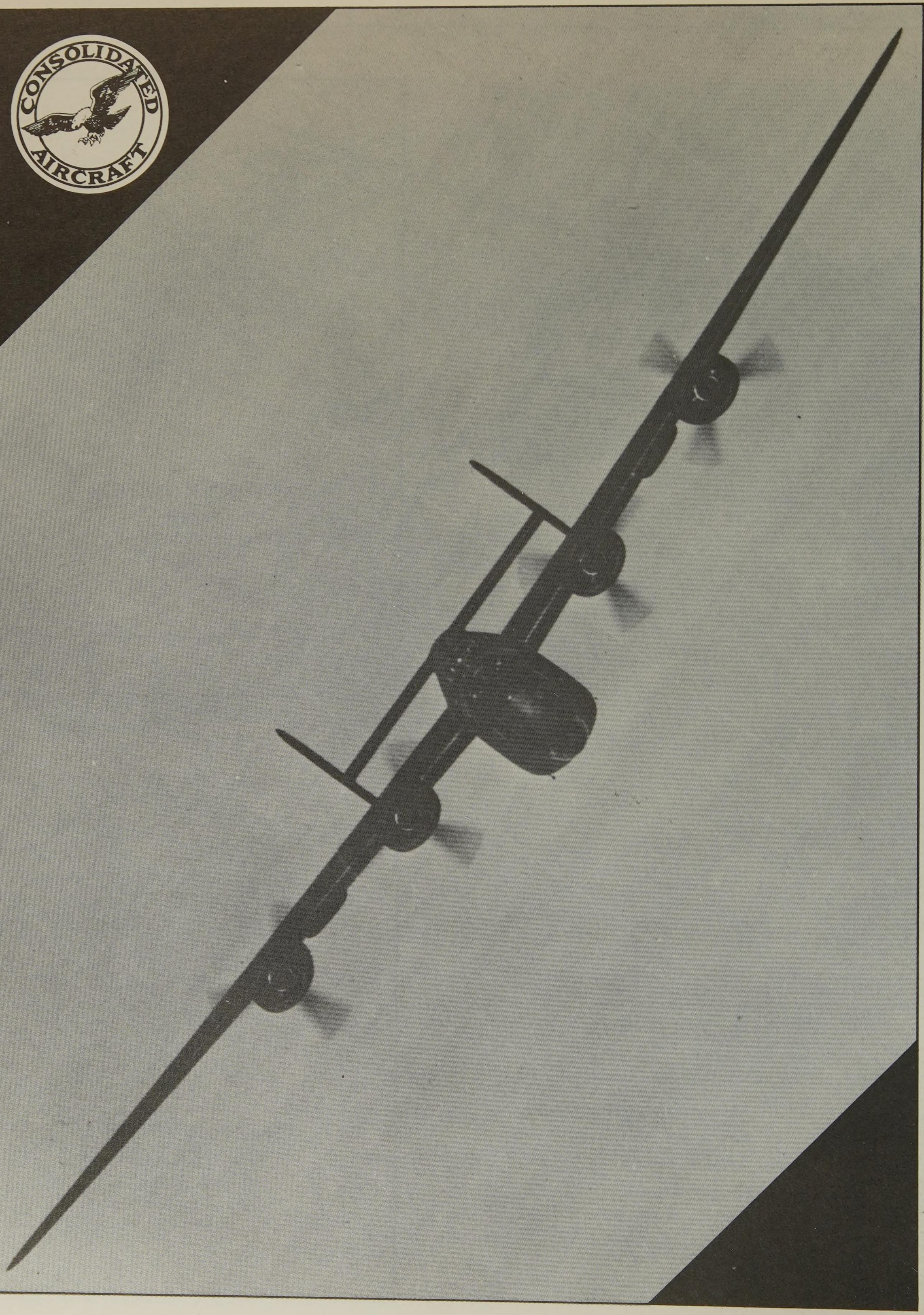


ANTI-ICER SYSTEM
B-24D
From the *Flight Manual*
B-24D Airplane.



SLINGER RING DETAIL
ANTI-ICER SYSTEM
B-24D
From the *Flight Manual*
B-24D Airplane.

CONSOLIDATED AIRCRAFT



6
Emergencies

When things go wrong, consult an authority. But the time to consult that authority is beforehand so that you'll be ready to act instantly in the most unnerving of situations. As a matter of fact, emergency situations do not unnerve the pilot who has prepared to deal with such unplanned and undesired situations. The summertime pilot may be considerably shaken by the sudden need to make an emergency landing. The pilot with the cool hand has studied the emergency procedures and has thought through the steps necessary to turn the unwanted event into a survivable situation. Next we might look at a situation which planning can take the terror out of, a situation which a confident and prepared pilot can reasonably hope to walk away from.

Forced landings:

Never a sure thing, a forced landing not on an airport can turn out better than ruinous if our pilot is resolute, practiced, thoroughly read, and lucky. Nothing can guarantee that a pilot will be highly resourceful; still, the careful pilot will be ready to do some practical things.

1. Radio your position to the nearest facility at the first indication of an emergency.
2. Always drop bombs over uninhabited areas or over enemy territory (not indiscriminately, but over approved areas). Secure loose equipment.
3. Always warn the crew immediately so they can prepare for bailout or take stations for a crash landing.
4. Have the engineer turn off fuel sight-gauge valves and wing-compartment drain-line valves located in forward bomb bay compartment on lower wing surface near the booster pumps.
5. Bleed the oxygen system if there is time.
6. Retract the ball turret.
7. Have fire extinguishers and first-aid kits handy to facilitate removal after landing.
8. Do not turn auxiliary hydraulic pump on if No. 3 engine is operating. If No. 3 is not operating, use auxiliary hydraulic pump to lower gear and flaps and charge brake accumulators. Then turn it off before the airplane makes contact, to reduce fire hazard in case the wing tanks are fractured and leak fuel into the bomb bays. Remember, the auxiliary hydraulic pump has an open-brush motor — and brushes spark.

There is, of course, the decision as to whether or not to land wheels up. Number 8 above assumes you'll land wheels down — not always the case.

9. Bail out in preference to making a forced landing at night.

Positions for bracing: pilot and copilot have seat belts fastened and shoulder harness secured. Others on flight deck lie down with feet braced against step as much out of the way of the top turret as possible. (The top turret, in a rough landing, may break loose from its mountings and come down onto the flight deck.) The men in the waist sit with back braced against the bulkhead aft of the bomb bay, or supine on the command deck or elsewhere in the aft section with feet forward and braced for impact. Crewmen who have been injured in a crash landing usually recommend placing the parachute and any cushions over their faces.

To land or not to land?

1. Over rocky, rough, or excessively soft terrain, always bail out if altitude permits.
2. It is sometimes possible to land wheels down on a road.

Caution: be sure the road is clear. The pilot would be at fault if innocent people were killed or injured. Don't land anywhere you'd put people on the ground at risk.

3. It is possible to land wheels down on a long, level, dry field, cultivated or not.

If you have a choice, don't attempt a landing unless you are reasonably certain of success.

Procedure after landing:

1. Remove fire extinguishers and first-aid kits when leaving the airplane.
2. Get out as quickly as possible.
3. Count the crewmembers and rescue any trapped personnel. Check for injuries and give first aid where needed.

B-24 in flight. Head-on view, doubtless taken from the tail turret of a preceding airplane.

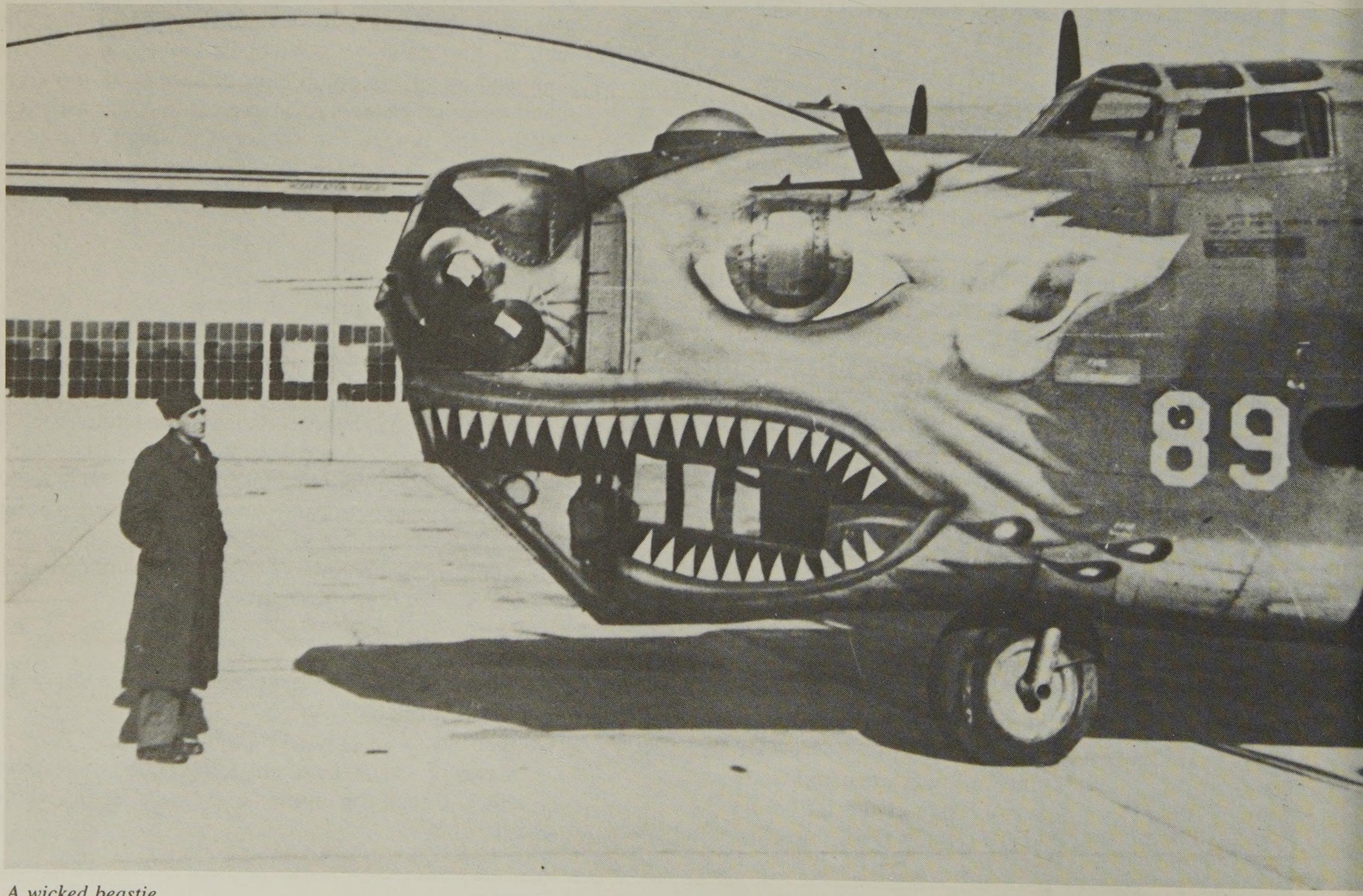
4. Inspect aircraft for fire hazards. Forbid smoking in vicinity of aircraft. Post guard and send word by nearest telephone to your base, or the nearest base, or send word in accordance with any special instructions in your possession.

Always bail out the crew if altitude permits: on any landing where there is serious danger of overrunning a short runway or where other circumstances make the landing hazardous, and if altitude permits, bail out all the crew except the engineer, copilot, and pilot. Before doing so, make certain each person understands how to leave the plane and how to use the parachute. The good pilot has already held ground drills on bailout procedures and emergency bailout signals. Never leave it up to the crew to decide whether they will bail out or not. They are daily betting their lives on their pilot and have nearly always developed a strong confidence in him; and so, if left to their own choices, aircrewmen nearly always opt to remain with the pilot. So, when the procedure is really hazardous, why not save their lives — tell them to get the hell out of there.

Belly landing: on rough terrain, land wheels up. If all emergency procedures fail to get the wheels down, land wheels up. Always use a runway if you can. Nowadays the crash fire people will spread foam for your landing, if there is time. Any landing off a runway will be less pleasant, because dirt and sod roll up into balls, breaking open the plane's underside and making it a scoop.

Procedure:

1. Bail out all souls aboard except engineer, copilot, and pilot.
2. Tell the tower everything, if you have radio — your intention, how much longer you can remain aloft, and where the crew will bail out.
3. Check seat belt and shoulder harness secure (pilot and copilot). If these two slam forward into the wheel, the nose is thrown down. Have engineer brace in a position where he'll be clear of a downward-hurtling top turret.
4. Release bombs at not less than 500 feet, in "safe," in uninhabited area.
5. Have the engineer turn off fuel sight-gauge valves and wing-compartment drain-line valves in forward bomb bay; drain the lines through the bomb bay drain valves.
6. Have the engineer check auxiliary hydraulic pump off and open the flight-deck escape hatch.



A wicked beastie.

7. Make a normal approach, using your checklist.
8. Flare out normally, holding sink to a minimum with power, contacting the runway at 105 to 110 mph. Be careful on impact not to shove the wheel forward. Bring the control column back as far as you are able and hold it there.
9. On impact, copilot should put the mixture controls in Idle cut-off and hit the crash bar (turn master switch off), which cuts off all switches, batteries, etc.
10. When the airplane stops, get everybody out as quickly as possible. Bring the fire extinguishers along.

No-flaps landing: landing without flaps reduces lift greatly and significantly increases the stalling speed in all cases. Use the longest runway wind permits. Make shallow turns. Maintain airspeed at 150 to 155 mph. Fly the final approach flatter so there is less change of attitude in the flareout. If the bird is heavy, approach 15 to 20 mph above the known stalling speed.

Plan contact as near the end of the runway as possible. Make flareout very gradually, carrying enough power to keep sink to a minimum. Contact the runway at 135 to 140 mph and immediately bring throttles full back. If there is ample runway, raise the nose to slow the airplane; if the runway is short, get the nose down quickly so that you can use brakes.

Difficulties with the landing gear:

The technical orders explain all the alternative procedures for getting the landing gear down and locked. If you have fuel to cruise around waiting to let the flight engineer become a hero, why not give him a chance? He has the tech orders with him on the airplane, he has read and made dry runs with the procedures. Every gear problem I ever had was solved by the flight engineer. But some problems just resist tech-order solution; most of these problems result from battle damage, but even so, an ingenious engineer can do something to make things happy-ever-after.

Nose wheel damaged and won't extend: wring your hands and radio the chaplain as much as you like, you'll still have to land; here you'll use all the crew for load distribution. Here again the good aircrew has been briefed and has had a dry run on the procedure. So brief them again as you prepare to land without the nose wheel down. Alas, the poor, overworked pilot may have to make another decision without help. A landing now in a strong crosswind is hazardous. Also, a landing on a short runway can do it to you. Decide on the longest runway unless the crosswind is very strong.

The school solution:

1. Land with the airplane level at 150-155 mph (160 with nose turret) and nose-down trim of 1½ degrees. You need seven men braced just aft of the bomb bay and forward of the waist windows.
2. Let the tower in on your intentions. If you have a formation landing, naturally you wait and land last, for you will stop on the active runway.
3. On final approach, assure yourself that the crewmen are in proper positions. Run the normal checklist.
4. Land on the main wheels at the slowest safe airspeed, power on to control the rate of descent, touching down as near the approach end of the runway as possible with the nose higher than usual but not dragging the tailskid.
5. Hold the throttles all the way back; open cowl flaps, and put inboard mixtures in Idle cut-off immediately after landing to get full propeller braking action. If necessary, use outboard engines for directional control; use an outboard engine to groundloop the bird if running out of runway.
6. Immediately after touchdown raise the nose until the tailskid touches. Gently, baby. Trim tail heavy to keep the tailskid on the ground.
7. When the tailskid starts to drag, one crewmember moves immediately to the extreme rear of the airplane. Give one ring on the alarm bell as you want each crewmember to move to the rear of the aft compartment. Five men should be aft by the time the airspeed has stopped reading and you judge airspeed to be about 20 mph. Send the other two men aft as the airplane comes to a stop. Note: the men in the aft section stay there until told to come forward. If they rush forward as soon as the plane stops, guess what happens? All that effort to save nose damage is wasted.

The same landing procedure works if the nose-wheel tire is flat or the shimmy damper is faulty. *Also,* this procedure works if you have no brakes.

Blowout on takeoff: in an earlier book of mine, *The Flying Game,* I described a blowout on takeoff in which a B-24 groundlooped at high speed; during rescue operations all the crew got out, but a cut battery cable provided a spectacular fireworks display and brought a brave young man an award of a Soldier's Medal for saving a fuel truck at the peril of his own life.

Thought and preparation for the emergency can make a takeoff blowout look routine, but don't cause one yourself by having your feet up on the brake pedals. If a blowout occurs early on the takeoff roll, you should throttle back and stop. Use brakes with caution or the blown tire may disintegrate, leaving tire parts heaven knows where. If you don't have room to stop, continue the takeoff; then land without ever raising the damaged tire into the wheel well. Here your problem becomes the next one we'll take up.

Landing with a main-gear tire blown: a bullet or a piece of flak can blow a tire without anyone knowing, so be sure to look carefully at the tires when you extend the gear. With awareness you can make a successful landing without doing other damage to the airplane.

Procedure:

1. Notify the tower that you have a flat tire and must stop on the runway.

2. If possible, use a runway with the wind coming from the good-tire side.

3. Cut sink to a minimum by using power as you approach touchdown.

4. Upon contact get the nose down as soon as possible and hold forward pressure on the nose wheel. Then the directional stability of the tricycle gear will help hold the airplane straight.

5. As the airplane slows, it will turn toward the blown tire. Use power on the flat-tire side and brake on the good-tire side to maintain a straight roll.

Landing with two main-gear tires blown: same approach as with one tire blown, but use a runway as nearly into the wind as possible. I have never done this bit, but I am told it is noisy with the bird shaking, thumping, and throwing rubber. You probably won't need brakes to stop, but if so, use them sparingly. Put inboard-engine mixture controls in Idle cut-off for additional braking.

Fire:

In the Liberator, the word *fire*, called out or seen, will get your complete attention. When fire broke out, the rule was accepted that no good would come of it. Yet fire didn't occur often in the B-24, so aircrews usually weren't gunshy about it. Except in combat. The Luftwaffe well understood the technique of starting fires in our airplanes, as did the Wehrmacht antiaircraft gunners. Our efforts to extinguish fires resulting from enemy action were not particularly successful, but fires resulting from ordinary operation were not common and their control was practiced for. But whatever the source of the fire, one had to initiate fire-extinguishing procedures, familiarity with which was everything. If the crew practices fire-control procedures, they'll act with less delay — an excellent thing with fires.

An old pilot manual categorized fires and lists step-by-step procedures for putting them out. In each case the first step reads, The pilot will: 1. Give command "Extinguish fire — (wherever)." This seems good advice. Then the crew will take the steps they've been trained to take, also appealing for help to the highest authority they can bring to mind.

For me, a fire I really don't want to encounter is engine fire in the air. To deal with this, the old book reads, Pilot will: 1. Give command "Extinguish fire in No. _____ engine." As a practical matter, this notifies the crew so they can look out the appropriate window, think over their past transgressions, and appeal to the most puissant authority for whatever they want most. The instructions continue (now for those who want to help themselves), Pilot will, 2. Order engineer to turn off fuel-selector valve. 3. Feather propeller of burning engine and place mixture control in idle cut-off when fuel in lines has been exhausted and fuel pressure has dropped to zero. 4. Warn crew to be ready to bail out if fire persists.

A line of B-24s awaiting takeoff.

Copilot will: 1. Close cowl flaps and turn booster pump off. 2. Place selector valve of engine fire extinguisher (panel on flight deck to right of copilot's seat) to position for burning engine. Other selector valve in Off position. 3. Pull the CO_2 release-valve handle of one bottle. 4. If fire persists, pull second release handle, opening remaining CO_2 bottle.

Engineer will: 1. Immediately place fuel-selector valve for burning engine in Off position. 2. Open bailout hatches if condition is serious.

Navigator will: 1. Determine location of aircraft at time of fire if distress signals are to be sent.

Radioman will: 1. Stand by to send distress messages.

Other fires: pilot will: 1. Give command "Extinguish fire in (location)." 2. Warn crew to be ready to bail out if necessary. Copilot will: 1. Turn battery switches off (if electrical fire). 2. Turn off all heater switches and valves. 3. Proceed with flight engineer to scene of fire, obtaining if possible the second CO_2 bottle from rear of airplane. Engineer will: 1. Proceed to scene of fire with CO_2 bottle from flight deck. Other crew members proceed as they did in the case of an engine fire, except that they may, at the direction of the pilot, go to the place of the fire to assist the engineer.

May you be successful in all these fire-extinguishing procedures.

Engine failure:

The Pratt & Whitney R-1830 engine is durable, reliable, and all the nice words you can say of it. During World War II combat in Europe, however, the engine failed with only a few hours on it. The reason was that the power settings were always high — maximum continuous power for hour after hour when flying formation with a full bomb and fuel load; full military power in many situations for times exceeding the maximum allowable; emergency power for as long as the

pilot thought necessary to save the plane and crew. So engines failed frequently with twenty or thirty hours of operation. If you climbed into the airplane and found an engine with forty or fifty hours on it, you took special note of it, watched it carefully on runup, and weren't surprised if it failed during the mission. Other theaters, I have been told, got more hours out of their power plants.

So all the crews in Europe got practice with procedures for coping with engine failure, which under ordinary cruising conditions might cause only slight concern. Engine failure close to the ground, on the other hand, got the old washer-cutter quickly into motion. The worst case, naturally, is engine failure on takeoff. And the worst engine to lose here, because of torque, is No. 1. And the worst moment to lose No. 1 is just at the point when you can't abort the takeoff and haven't yet reached flying speed. Engine failure when you have plenty of runway ahead offers a simple solution. Chop the power and bring the airplane to a stop, then taxi back to the line. Otherwise you follow your thoroughly memorized procedure.

During World War II, pilots in B-24 traning walked around muttering Auto-rich, Full high, Power applied, since these were the first three steps pilots called out for emergencies. Call number four was Help on the rudder. Help on the rudder? This fourth call didn't appear on early checklists, but experience showed the absolute necessity for keeping directional control and also made clear the uncomfortable fact that slightly-built pilots needed help to maintain this control.

When No. 1 fails on takeoff and you must take off: already you have auto-rich mixtures, full high rpm, and full power. Ask for help on the rudder. Show the crew how cool you are.

Feather the correct engine. A thumb push on the wrong feathering button will be the last procedural move you'll ever make. As a matter of fact, you must move the correct control in every case, or. . . . With a full combat load, you can get the airplane to fly off the ground at 130 to 135 mph. Since this will take a lot of runway, hold your nerve and fly smoothly. As soon as you are definitely flying, tell (and signal) the copilot to raise the landing gear. The airspeed will likely hold steady. If there is no obstacle on the overrun airspeed could at last reach 140 mph, at which time you can entertain a hope of flying another day. You have 20 degrees of flaps down. You'll be able to climb if you can get flaps up about 10 degrees. Tell the copilot to milk them up, which means a degree or two at a time, returning the handle to neutral for a few seconds to let the airplane stabilize, then milking up a degree or two more. Soon the airspeed will increase very slightly, and you'll need to convert some airspeed to altitude, for that church steeple ahead is higher than you are. Think of the consternation on Sunday morning. Until 1945 the tech order didn't say what flap setting to work for; the authorities decreed 9 degrees after the B-24 was no longer operational. In my own experience, airspeed began to rise at 12 degrees of flaps, so that was the correct setting. Now land the bird at once on the nearest suitable runway, possibly the one you left, making your turns away from the feathered engine — and don't go around; you've already had enough fun for one day. If you survive No. 1 engine failure on takeoff, the others are easier. The amplified checklist for feathering ought to be in your memory, so it follows.

1. Feather. Upon determining which engine is defective, pilot presses (or directs the copilot to press) the feathering button in and removes his hand. The button should kick out when the propeller feathers. If not, the propeller will unfeather. In this case, press the button again and pull it out when the propeller stops in the feathered position.
2. Mixture and fuel-booster pump. Copilot moves mixture control to Idle cut-off and switches fuel-booster pump off. This is necessary at times to stop the engine.
3. Application of power. Copilot adjust mixture controls on other engines and increases rpm; pilot increases manifold pressure. The copilot's actions here must precede the pilot's to avoid excessive BMEP, which can split cylinder heads on the other engines. (BMEP stands for Brake Mean Effective Pressure, the limits of which are shown in power charts.)
4. Gear up. If the landing gear is down, pilot directs copilot to retract it.
5. Trim airplane. Pilot trims, or whoever has the controls trims.
6. Cowl flaps closed. Copilot closes the cowl flaps on the dead engine to decrease the drag and opens the cowl flaps to Trail on the operating engines (if cylinder-head temperatures are high).
7. Ignition off. Copilot turns ignition switch of dead engine off.
8. Generator off. Engineer switches dead engine generator off.
9. Fuel valve off. Engineer switches dead engine fuel valve off.

After feathering: once an engine is feathered, try quickly to determine the cause of engine failure. The same condition may exist in other engines. All too frequently a second engine will fail before the crew has determined why the first engine failed. The pilot should avoid putting too much power on the remaining engines to avoid additional engine failures. Use only the amount of power you need to complete the mission. To save power and maintain altitude, you can jettison things you don't need, but don't throw away the tech orders if you can help it.

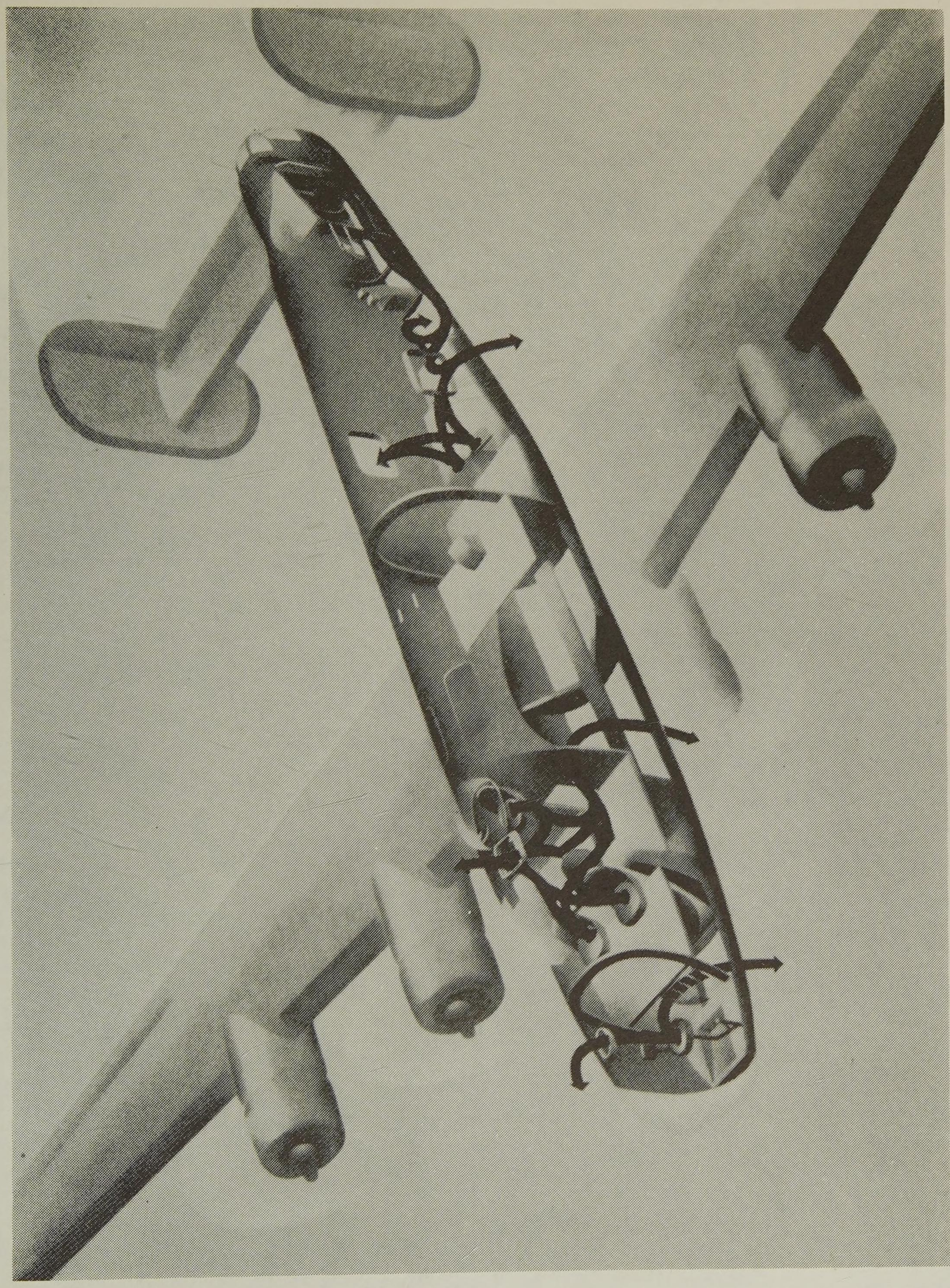
Feathering problems: if the feathering button doesn't start the feathering procedure, simultaneously

New, unmarked airplanes await assignment of combat crews to take them to war. Such a scene awaited the author in the "pea patch" at Hamilton Field, California.

hold down the red circuit breaker on top of the pedestal. Don't hold it down more than ninety seconds.)

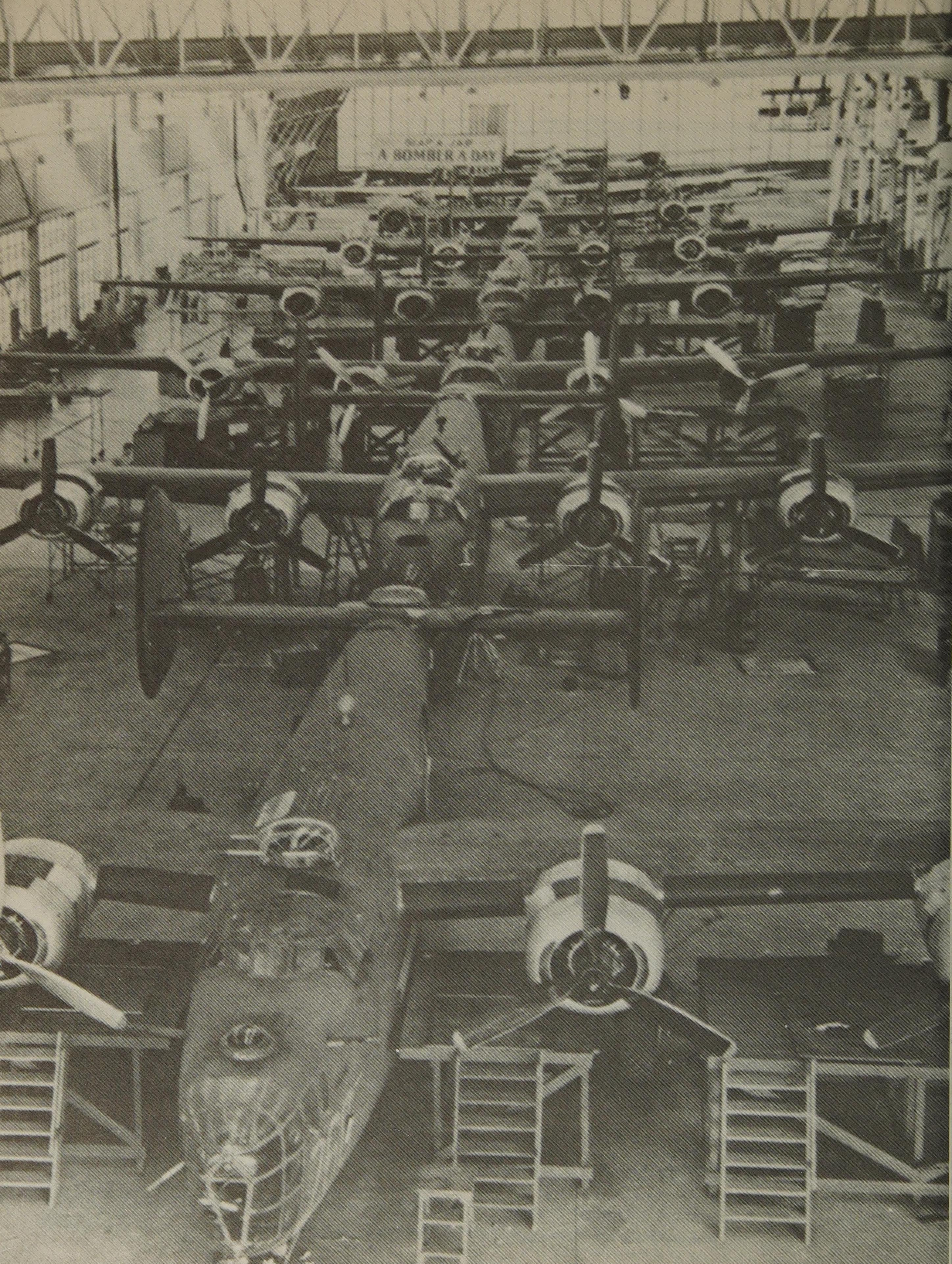
If you have lost all the oil and can't feather: the book says to reduce rpm to reduce windmilling drag. Always optimistic, these dudes telling you to do something when there is nothing you can do. But never fear, here comes a wild story of the young hero who feathered an engine without oil. A fair-haired young copilot friend of mine told me how he feathered a windmilling engine without oil. He *thought* about the problem and proved forever that aircrews do think. Unable to maintain altitude while coming back across the Adriatic from a combat mission in which they'd sustained much battle damage, they'd tried to feather a windmilling engine. No oil, no feather. Now it takes a gallon of oil to do this job, but that information is about as useful as knowing how much runway is behind you or how much altitude is above you. They kept losing altitude until, the pilot said, "We were siphoning water into the bomb bay." Then, our young copilot said, "Ah," and started the oil dilution switch pumping gasoline into the oil sump. After a time, he pressed the feathering pump; the engine feathered. The airplane was able to gain enough altitude to land at Bari, a base beside the Adriatic.

Happy ever after, except for the maintenance people next day who were angry when they removed the propeller dome and got drenched in high-octane aviation fuel. They, in a righteous fury, reported the failure to follow standard procedures. They demanded information from the combat crew about why they didn't explode, as they should have. Young Carter Wattman, confronted with his unconscionable behavior, scratched his head and admitted his ignorance, but those maintenance people had already made sure that his ingenuity would not ever be everywhere forgotten.



Page 96] EMERGENCY EXITS AND EQUIPMENT RESTRICTED

Bailout: Illustration taken from the ***Flight Manual B-24D Airplane****, 15 Sept. 1942.*


A BOMBER A DAY

7
Bailout and Ditching

Readers readily believe that bailout and ditching are major emergencies. Believe it.

Bailout:

The aircraft commander, on every flight, makes certain:

1. That every person making the flight has a satisfactorily fitted parachute.

2. That the parachute is conveniently located at the normal position of the person making the flight and that he knows its location, how to put it on, how and where to leave the airplane, how to open the chute, and how to land and collapse the chute.

3. That a life vest is worn under the parachute harness on all overwater flights, and that the crew knows the location of, how to attach, and how to use the individual seat-type dinghy.

4. That all persons aboard know the bailout signals and the bailout procedures to be followed.

The best procedure is to appoint a parachute officer or noncom, usually the flight engineer, who will make a study of the equipment, its use, procedures, and signals to be followed. He then conducts on-the-ground practices of the procedures once a week until the entire crew is proficient in the steps to be followed; thereafter, he conducts drills frequently enough to keep the crew proficient in the techniques on proper use, wear of and care for the equipment.

When to bail out: in all cases, it is the responsibility of the airplane commander to decide when a bailout emergency exists. The commander should never put it up to the crew. In case of fire, fuel exhaustion, midair collision, weather, or other circumstances that make a landing dangerous, only the aircraft commander can make the decision about the extent of the danger and the necessity for bailing out the crew.

Radio your position: as soon as you see an emergency developing, get your position from the navigator; then have the radio operator broadcast your position and your difficulty. This can save rescuers a lot of time.

Bailout signals: check to be sure all crew can hear the alarm signals.

Prepare to bail out: three short rings on the alarm bell. If possible warn the crew by interphone and obtain acknowledgement from each one.

Bail out of the airplane: one long sustained ring.

Don't bail out: if you have given the warning signal "Prepare to bail out," don't hit the bell again or the troops will all leave. If you want to call off the emergency, send the engineer to do it or notify all crewmembers by interphone. Any canceling bell signal arranged by the pilot usually results in some crew members making the nylon approach, or as they said in early days, hitting the silk. Explain that inadvertent bailout back at operations.

Bailout procedure:

1. At the signal "Prepare to bail out," all the crew will acknowledge by interphone and make immediate preparations to leave the ship, checking parachute snaps and attaching the quick-attachable chute if so equipped.

2. Pilot directs navigator or bombardier to open the bomb-bay doors and jettison bombs (careful, baby, bombs in Safe) to provide clearance for jumping; navigator will open the nose-wheel hatch by pulling down on the two red handles at station 1.0 on the crossmember under navigator's table; tail gunner opens belly hatch. These are the three best bailout exits.

3. Crew should check each other's equipment to make sure it is properly fastened and attached.

4. Pilot slows aircraft down to 150 mph (to 140 mph with 20 degrees of flaps) before giving bailout signal.

5. Order and method of leaving the aircraft:

a. Navigator, bombardier, and nose-turret gunner leave the aircraft by the nose-wheel hatch, one after the other, facing front of the ship, crouching near opening with hands on each side and lunging headfirst and forward.

b. Tail gunner leaves from the belly hatch, followed by left waist gunner, by crouching facing the front of the airplane, and lunging headfirst and forward through the hatch.

c. Ball-turret gunner and right waist gunner leave through the rear bomb bay; flight engineer, radio operator, copilot and pilot all leave in that order through the bomb bay, crouching on the catwalk facing the front of the airplane and lunging headfirst and as much forward as possible.

Warning: it is extremely important in all cases to face the front of the B-24 and lunge out and forward headfirst. The airplane is traveling fast and if you jump toward the rear there is danger of being slapped up against the airplane. If you jump feet first, the wind can catch your legs and bang your head on the edge of the hatch. If the airplane is in a turn or a spin, lunge toward the inside.

6. Don't pull the ripcord until you have straightened your legs and are well clear of the airplane. In those days, the Pilot's Information File (P.I.F.) gave clear instructions on how to fall and how to land under various circumstances, including how not to come down straddling a fence.

When the three-bell warning signal sounds, say your goodbyes to the airplane rapidly. When the bailout bell rings, *go*. Time for reminiscences doesn't exist. Thinking is still important, even as you hasten to leave a burning plane. I knew a crew most of whose members perished when they bailed out of a fiercly burning airplane. The great flames in the bomb bay caused the unfortunate crewmembers to cross their arms across their faces, leaving their chest chutes unprotected. Those chutes burned on the descent and let the men hurtle fatally to earth. I saw no successful bailout from that stricken plane and so was startled after the war to see the pilot walk up to me. I gasped, "The last time I saw you was over Blechhammer (Germany) in a burning airplane. I thought all of you got it." Winfree the thinker answered, "When I bailed last, I saw burning chutes. I crossed my arms over my chest-pack, and all I got was a burned face, which the German plastic surgeons restored, using pictures from home as guides. Now I look as if I have a deep sunburn, permanent type."

Ditching (landing in water):

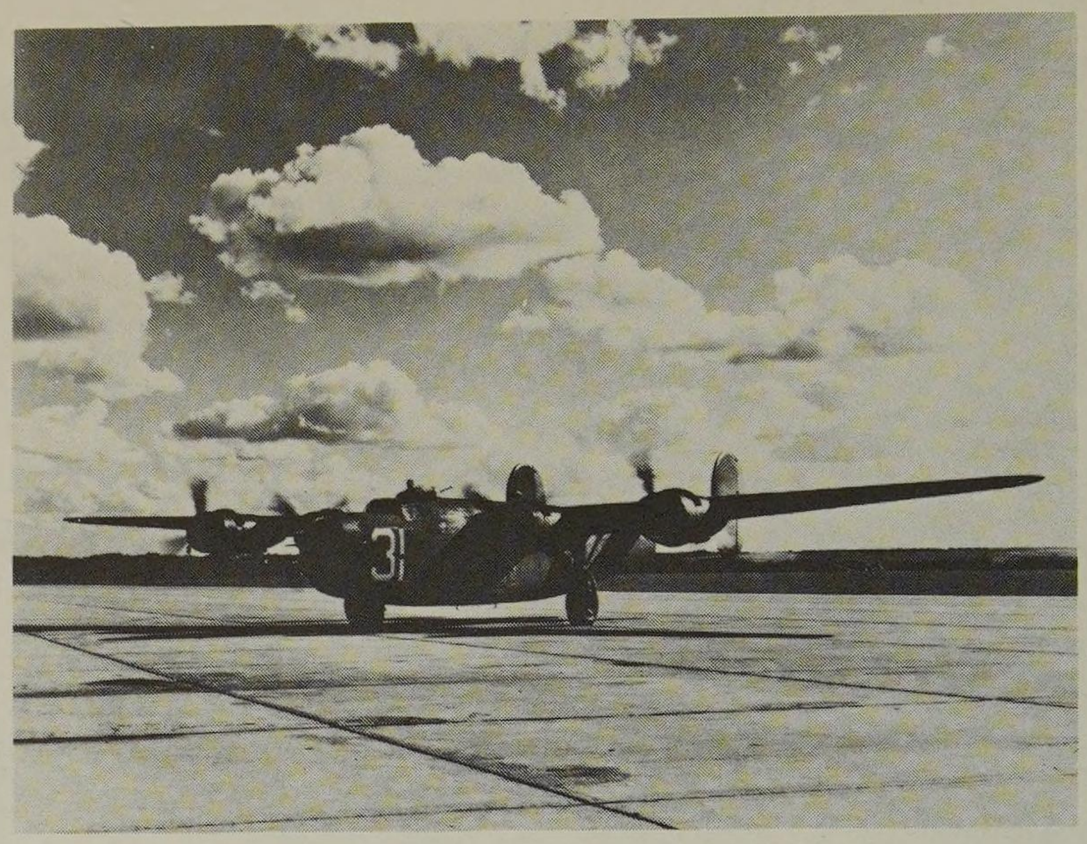
The old flight manual says the best procedure for ditching is to conduct your flight in such a way that you don't need to ditch. Superb advice, especially since not much experience with ditching existed in early days.

To keep from ditching, remember: if you aren't maintaining altitude on two or three engines, lighten your load.

1. Jettison the bomb load.
2. Jettison guns and ammunition if not in danger of attack.
3. Jettison camera and all equipment not necessary for survival on the sea.

If possible, be ready to ditch before you get below 1000 feet. But don't give up flying the airplane if you have sufficient fuel. When the load is lightened, you may still be able to keep the plane in the air with smooth flying and proper control.

Enemy fire, weather, or other circumstances may force you to ditch. Now your training and drills can



The B-24s were painted olive drab until April 1944.

save lives. A margin of 30 seconds may mean the difference. When you decide that ditching is the only course, give the order "Prepare for ditching." Each crew member, if drilled sufficiently in the procedures, will perform almost automatically in the correct way.

Ditching officer and drill: designate one member of the crew, usually the copilot, as ditching officer. Require him to brief the crew on the problems of ditching and to keep abreast of the latest information on it. At least once a week, conduct a ditching drill as you return from a practice mission. Require the entire crew to take ditching positions and simulate a ditching operation. On the ground with props stopped, have the crew leave the airplane through their assigned ditching exits — if you can get them to do so without injuring themselves. Have them exit in the correct order with all equipment except the life rafts. Time the operation. Inspect crew members with your ditching officer to see if equipment has been forgotten. Check the crew's understanding of the duties they will perform in a real ditching and satisfy yourself that they are thoroughly familiar with the equipment. All members of the crew must wear their life vests (Mae Wests) at all times on overwater flights and understand their use.

Ditching procedures for the B-24: the moment a ditching emergency arises the pilot gives the crew the signal to take ditching positions, informing them of the altitude and the expected number of minutes before impact. Receipt of this information should be acknowledged by the crew in the order of copilot, navigator, bombardier, nose gunner, flight engineer, radio operator, right waist gunner, left waist gunner, belly gunner, and tail gunner, with the words, "Copilot ditching, "Navigator ditching," and on through the crew. A ten-man crew might have only one waist gunner if it has a nose gunner, or it might not have a bombardier. The pilot will necessarily adapt crew instructions accordingly.

Alarm-Bell ditching signals:

1. Crew to ditching positions — 6 short rings.
2. Brace for ditching — 1 long ring just before impact.

Procedure: immediately, all crew members should loosen shirt collars and remove oxygen masks. Note to pilot: don't give this signal above 12,000 feet unless you are going to ditch on Lake Titicaca, where the crew will need oxygen masks.

All crew members wearing winter flying boots should remove them, but remove no other clothing. Then each crew member performs his specific duties. Have life vests on but do not inflate them before landing.

Upon specific order from the pilot, crew members will remove parachutes and parachute harnesses.

Duties before landing on water: pilot: after giving the warning he remains in the normal flight position for ditching — in his seat. Fastens safety belt and shoulder harness but unfastens parachute straps. Shortly before impact he gives a long ring on the alarm bell to notify the crew to brace for ditching.

Copilot: remains in normal flight position. Unfastens parachute straps and fastens safety belt and shoulder harness. Assists pilot as necessary.

Navigator: calculates estimated position of ditching and gives it to the radio operator. Destroys secret papers. Gathers maps, compass, and celestial equipment. Goes to flight deck and takes ditching position.

Bombardier: jettisons bombs and closes bomb-bay doors. Destroys bombsight. Goes to rear compartment, checks position of others and takes ditching position.

Nose gunner: jettisons ammunition, locks nose turret in forward position, and goes aft to ditching position.

Flight engineer: turns guns aft. Shoots out or jettisons ammunition. (Avoid getting shell cases jammed in the bomb-bay doors.) Opens and removes top hatch and jettisons it and loose equipment through the bomb bay and checks it closed. Closes floor door and rear door to flight deck after navigator comes up. Takes up emergency ration box (I never did see one of these) and takes up ditching position.

Radio operator: turns IFF (Identification Friend or Foe) to distress. Switches on liaison transmitter (turned to MF DF frequency), sends SOS, position, and call sign continuously. On order from the pilot he clamps down key, hinges up radio table and takes ditching position after attaching rope of emergency radio equipment to his arm.

Left waist gunner: opens left waist window and leaves it open; jettisons left waist gun, ammunition, and all loose equipment preferably through belly hatch to avoid damaging tail surfaces. Gets emergency ration box and attaches it to arm. Takes ditching position.

Right waist gunner: opens right waist window and leaves it open. Jettisons right waist gun, ammunition, and loose equipment, preferably through the belly hatch to avoid damaging tail surfaces. Secures water or supplies, goes to ditching position and remains on interphone.

Belly gunner: retracts belly turret and jettisons ammunition, preferably through belly hatch if time permits. Takes ditching position.

Tail gunner: lines up turret directly aft and locks. Comes out of tail turret, helps jettison ammunition. Checks belly hatch firmly closed; secures emergency radio rope to arm. Takes up ditching position.

Warning: if time permits, waist windows should be jettisoned through the belly hatch to avoid danger of their closing and jamming shut on impact. It is most important that all bottom hatches be closed and that the top hatches and waist windows be open.

Ditching positions: it is difficult to specify exact ditching positions for each crew member because location and type of equipment will vary. Ditching officer should study recommended positions and check them during drill. There are three suitable general positions: the flight deck, the rear compartment forward of the waist windows, and the half deck. The half deck is one of the best ditching positions in the airplane and as many men as possible should be there with feet braced forward, protected with coats and cushions from sharp edges. The men on the half deck could aid others if injured by water or carried back into tail.

Lying down with feet braced forward is the best position for ditching. If in a sitting position with back braced against a solid surface, head should be clasped in hands to hold it against the snap of impact.

The dangers from a hard landing are that the top turret can be torn loose; and if bomb-bay doors are caved inward, water may fracture No. 6 bulkhead and flood the rear compartment.

Definite ditching-position assignments should be made after consultations between the airplane commander and the ditching officer. The time for the consultation is the same as that time to turn to heaven as specified by Ben Karshook: "Turn today."

Usually those on the flight deck will include pilot, copilot, navigator, flight engineer, and in some airplanes, the radio operator. In later airplanes the R O station was on the half deck (in the aft section above the rear bomb bay.) Those in the rear compartment or on the half deck usually will include bombardier, the two waist gunners, nose gunner, belly gunner, and tail gunner, as well as a photographer if you carry one.

Technique of landing the airplane: to land the airplane properly, the pilot must determine the direction of the wind, wind velocity, and the character of the waves. Consult with the navigator and your Pilot's Information File to develop some expertise in making these decisions. When flying over water the pilot must

develop some judgment about the seas, waves, ground swell, and wind. This is another skill you need to develop before the day of the grim event.

In a B-24 ditching, avoid a high rate of sink. That's one reason why you jettisoned everything except the shadows. Get the airplane slowed down before you start your glide, and control the rate of descent with power if possible. Approach the surface with half flaps, bringing down full flaps to slow the speed as you flare out. Best technique is to approach at low airspeed and low rate of descent. As everywhere else, grease it in — it means more here. Don't attempt to land tail low, because this puts too much strain on station 6. Don't drop it in or you will collapse the bomb-bay doors and force water against station 6, to the consternation of the crewmen in the aft section.

Note: I never ditched the B-24, which is attended with a somewhat low rate of success; but the techniques are those recommended by ditching survivors.

Landing on a calm sea: if the surface of the sea is calm, without white caps or waves, land upwind.

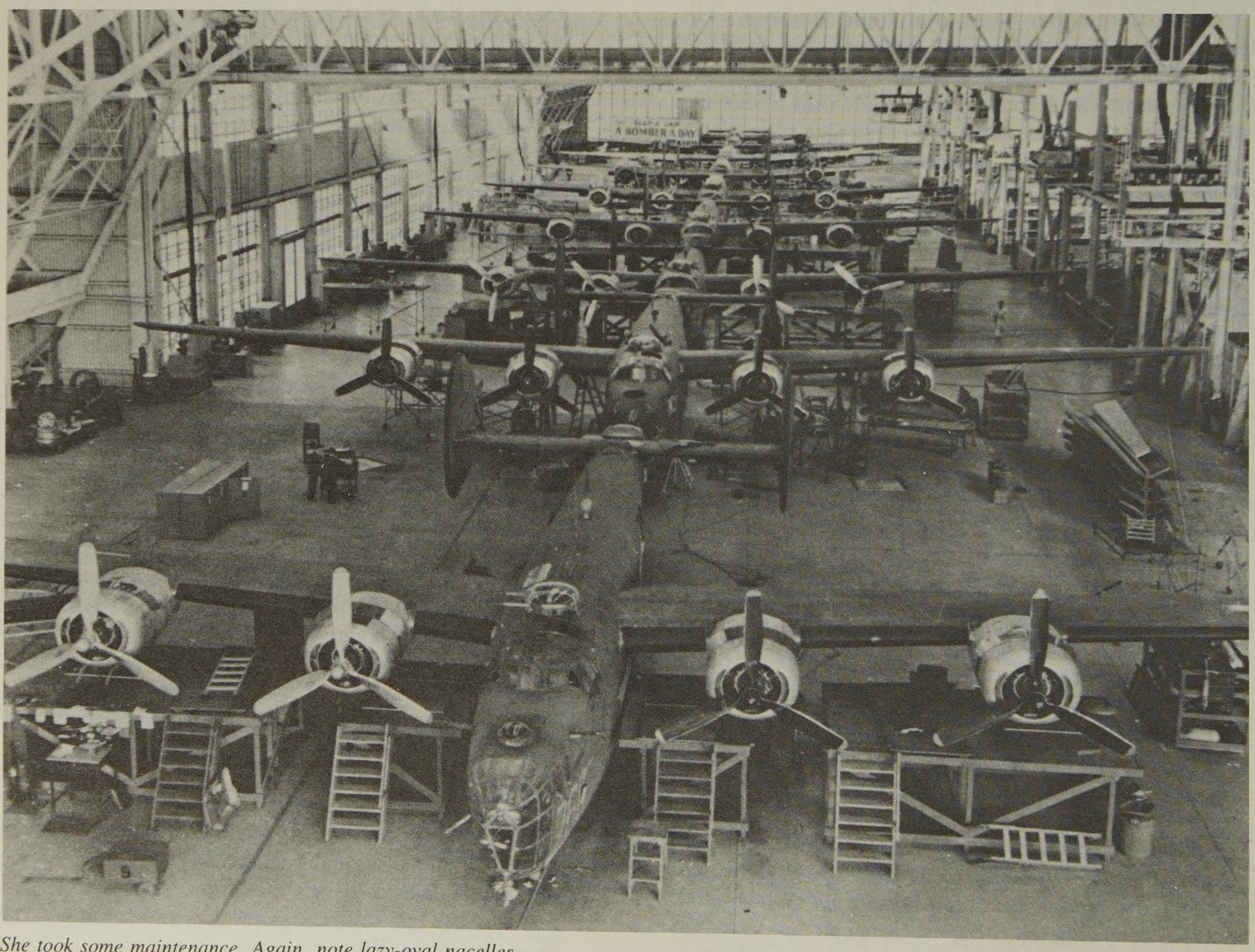
Landing on a swell: when white caps exist but foam is not being blow into spray, ditch along the top and parallel with swell.

Landing in high waves, if foam is whipped into spray, wind velocity is too great to land crosswind. Ditch upwind on upslope of wave. This is the procedure for a high wind and a heavy sea.

Caution: there may be more than one impact. Warn the crew to hold positions until the airplane comes to rest.

Procedure after landing: the airplane will usually remain afloat from one to five or ten minutes. As soon as the airplane comes to rest, engineer will pull releases on the life rafts. Crew should exit as fast as possible with necessary equipment as follows.

Through the flight-deck hatch (each man inflates his life vest after clearing hatch): navigator first, receives emergency radio (if stored on flight deck) from radio operator or flight engineer and goes to left raft. Radio operator second after passing emergency radio to navigator, goes to left raft. Engineer third, receives ration box from copilot and goes to right raft. Copilot fourth,



She took some maintenance. Again, note lazy-oval nacelles.

B-24D. Beauty and the Beast. Photo from the Hill AFB, Utah Office of History.

after handing ration box to flight engineer, goes to right raft and takes command. Pilot fifth, hands out water and other supplies and goes to the left raft and takes command.

From rear compartment (life vests should be inflated after individuals are clear of waist windows so vests won't interfere with exits if hatches are under water): right waist gunner or nose gunner first through right waist window to right raft, carrying water or other supplies, followed by bombardier to right raft. Left waist gunner first through left waist window to left raft, holding ration-box rope; tail gunner second, through left waist window after throwing out radio (if in his charge) holding tightly to rope, to left raft.

Note: if time and circumstances permit, take out the frequency meter and be sure to keep it dry. By attaching antenna from the Gibson Girl emergency radio to frequency meter, it can be operated as an efficient receiver to provide two-way communication for several hours. (The emergency radio was called a Gibson Girl because it was pinched in at the waist; flyers remembered that suggestive curve, so the name stuck.)

The time element: speed is important but so is procedure. Give first attention to injured persons. Don't leave necessary equipment behind; you're likely to need it later. Your earlier drills will keep you from forgetting things.

Survival: the ditching officer should study the PIF and survival booklets, instructing crew so all will know how to make the most of life raft equipment, how to signal, and how to survive on the sea.

Life rafts: Two Type A-2 life rafts are carried in the fuselage above the wing and slightly aft of the top turret. To release either raft from inside the airplane, pull the T-handle, on early aircraft located at the rear of the flight deck, left side. On later airplanes the T-handle is just aft of the pilot's escape hatch. The pull cable releases the lock pins which hold the life raft doors closed and allows the spring bungee to throw the raft out, clear of the fuselage. A ripcord attached to the raft cradle automatically opens the valve that controls the raft inflation from the CO_2 bottle. To release either raft from outside the airplane, the lever flush in the fuselage aft of each door should be lifted and twisted 90 degrees. This action pulls the same cable and releases the raft in the same manner as described above. Do not release rafts until airplane is at rest in the water. (This writer has spent many pleasant recreational hours in an A-2 raft. Practically unsinkable, it gives on sharp rocks without puncturing and resists capsizing, quickly building the user's confidence.)

8
Forming the Aircrews

All those eighteen thousand B-24 Liberators are memory — fading photographs, confused recollections, a few sparse records. Some of the scanty memoirs are false, accidentally or intentionally, some as innocently as embellished tales to children, some as tarnished as hyperbolic recountings meant to cover personal failures. All told, however, many of these bits float about the world, because people involved with the B-24 outnumber those involved with any other airplane, in any country, in any time. The B-17, on the other hand, didn't exist in quite those large numbers, had fewer people involved with it, and was not involved in as many diverse actions as the B-24. Yet the B-17, I believe, has had more kind words said about it than has the B-24. Many of the kind comments about the B-17, however, were made by people who never saw it. The B-24, conversely, has been widely maligned, usually by people who don't know the airplane, who "had a flight in it," who washed out of it, or who declared fear of flying.

Both were superb airplanes. I flew both of them and know both of them. I like both of them; but, perhaps because I flew the B-24 in combat, I have fonder memories of the B-24. I liked the B-17 because it allowed pilots to live even when their attention strayed or their flying was sloppy. The B-24 was a less forgiving airplane, and fewer forgiven pilots survive it. I like to think I survived the B-24 because I was a better pilot. Vanity, vanity. But I did learn the old girl's tricks, which any pilot could do, and I had luck, which some did not. Also, I had quite a good memory, and that made some difference.

The B-24 was strictly a War Two airplane, not operational before the war, not operational after the war. Nearly every B-24 was cut up into pieces of scrap before the dust and smoke settled at Hiroshima and Nagasaki. The great B-24 groups in Europe were inactivated almost immediately after V-E Day. Yesterday's gods are todays devils. So the B-24, so intimately wound into the horrible war memories of so many people, was enthusiastically turned to scrap. Even the air museums of today are unable to find a B-24 to set out on a ramp and put a placard on. The only B-24 in a museum, as far as I know, is the "Strawberry Bitch," an old B-24D in desert dress, which sits in the Air Force Museum at Wright-Patterson Air Force Base, Ohio. That "D" is not even the airplane that won the war; that airplane was the four-turret B-24 (models G, H, and J) that shut off the German's fuel from Ploesti. There is, as of 1987, one B-24 (J, as I recall) based in Southern California and flying in occasional World War II air shows. May it end its days in the Air Force Museum, and may you have the chance to see it.

All a memory of the Second World War, and a fading memory, washed in the rosy, uncertain recollections of the hundreds of thousands of people who flew and supported it.

America developed the plane and the systems to get it into the sky over the enemies of America and its allies. All told, the B-24 story is one of national will; but it comes down to a story of the Army Air Forces once the plane went into production. Gathering and training the aircrews, building the bases and facilities for training, and arranging the logistical support all fell on Army Air Forces staff and commands. As one individual in a then-foggy system, I was always steadily impressed with the prodigious efforts of people to make the system work — clumsily or cleverly — and to make it constantly work better. I can't remember ever being hesitant about telling appropriate operators what I thought was wrong; I was anything but alone, so we who stood and bitched may have helped the doers see better ways.

I must admit that the whole thing was still a mess when the war ended.

The main pipeline bringing people to man the B-24, if we focus on aircrews, was that bringing men through the training schools. Most numerous were the aerial gunners, who came to the B-24 aircrews as staff sergeants, usually directly from aerial gunnery schools where they were qualified on .50 caliber machine guns. Most gunners were qualified on turrets — tail, nose, ball, and top. At least one gunner had been to flight-engineer's school, one had been to radio-operator's school, and one to armament school where he learned to load and fuse bombs, among other things. Men so trained filled the six enlisted spaces on an aircrew. The leader of these six enlisted men was the flight engineer, whose maintenance training had taken more time. Many engineers had been to flight schools, which they

had failed, for one reason or another, to complete. Of course the same could be true of any of the six enlisted crew; but their keen desire to fly in any aircrew position got them to gunnery school.

The remaining four crew positions were filled from graduates of flight schools who were usually commissioned as second lieutenants — occasionally as flight officers — upon successful completion of flying school. Two graduated from pilot's school, the pilot earlier. He'd gone through a B-24 transition school of about three months and had become fully proficient in flying the B-24. The copilot, usually, had just graduated from pilot's school, probably without any time in the B-24. But sometimes the copilot came from some other type of aircraft, voluntarily or involuntarily changing to the B-24. These pilots almost never volunteered to be copilots, but, ah, the country's need was paramount. Still, Why me, Lord? The navigator and bombardier were usually newly graduated from their respective training schools. Many of these had taken an unsuccessful shot at pilot's school, and their keen interest in flying caused them to accept their second choices.

Ten men wearing silver wings thus came together to man one B-24. And those wings were date bait. The girls of the early forties liked those wings, for Hollywood had also done its part in making the flyers seem glamorous. The girls also knew that those wings meant extra money in flyers' pockets. In my case, half of my base pay of $150 a month meant $75 flying pay in my pocket every month. Whee. A short life but a gay one.

Most young men, as soon as the message of Pearl Harbor reached them, thought favorably about the flying game. The Air Corps saw to it that they got the information about becoming flying cadets. As recruitment boomed along, the managers saw a need for classification centers, and these brought in the eager beavers who passed the physical examination and qualified under some other requirements — under twenty-seven years of age, two years of college (later dropped), unmarried (later dropped), and various stipulations about good character — to be classified according to aptitudes and assigned to a flight-school program. The aptitude tests worked fine if you were selected for pilot school. If you were selected for some other school, you could see the faults in the system. Pilots used to say the classification tests sorted cadets into three bins: pilots were chosen from those who gave quick and correct answers; bombardiers were chosen from those who gave quick and erroneous answers; navigators were those who gave slow and correct answers. Being a pilot, I never knew what navigators and bombardiers said of the classification tests. In practice, I found all kinds in all the bins, and the centers kept filling the schools with people who willingly served in all these honorable specialties.

I enjoyed my own practice of navigation, for it was satisfying to solve the sometimes difficult problems of getting to a precise destination at a precise time. When no navigator was aboard, I had to make a good flight plan. I had great pleasure in learning the bombing systems and felt the satisfaction of accurate bombing. I loved to go aft to the waist section and practice marksmanship with the turret guns and the flexible guns. I enthusiastically played all the parts, but supremely I was happiest flying and commanding the airplane. Leading formations was only a slight extension of the flying, basically a smooth-flying pilot's job, with foresight and planning added.

At any rate, the system got the B-24 crews together and bundled them off to combat phase training for three months. In our case it was Muroc Army Air Field, California. This base is now called Edwards Air Force Base, located at Rogers Dry Lake (wet in winter) in the Mohave Desert. Once checked in there, the busy time started. The only man who knew the B-24 was the pilot; he had to teach the whole crew the airplane and get them to understand the important concept of Aircrew. Probably his foremost task was to teach his copilot to fly the airplane; and that copilot, just out of flying school, had to be fully qualified to command the airplane by the time the crew left this school and headed for the next stop — combat.

The pilot was not unaided in making the assigned men into a crew; the whole base was lined up to do the job. A cadre of combat returnees was assigned to help train the crews, to teach and check the pilots, to work with the bombardier and the navigator, to hold ground schools on aircraft systems, and to try to teach me how the hydraulic pump worked.

Muroc was isolated in those days. Commercial transportation was almost nonexistent; very few of the people in training had cars; the big entertainment was to go over to the mess hall to get warm (we were there from January to April and the tarpaper barracks were unheated). We trained for eight days and were off for two; Hollywood was 110 miles away, so we were warm for two days out of ten. In summer, training crews had the problem of desert heat. And what was air conditioning? But winter was brief and mild, so I think we had the best of it. Plus, I met and learned to admire Pancho Barnes, one of the world's greatest women flyers. Pancho was running a school for women flyers, checking them out in multiengine planes. In those days it was almost the only way women could learn to fly heavier airplanes. And she wasn't running any beer joint. Pancho had a cash register behind her bar, but it wouldn't take any money.

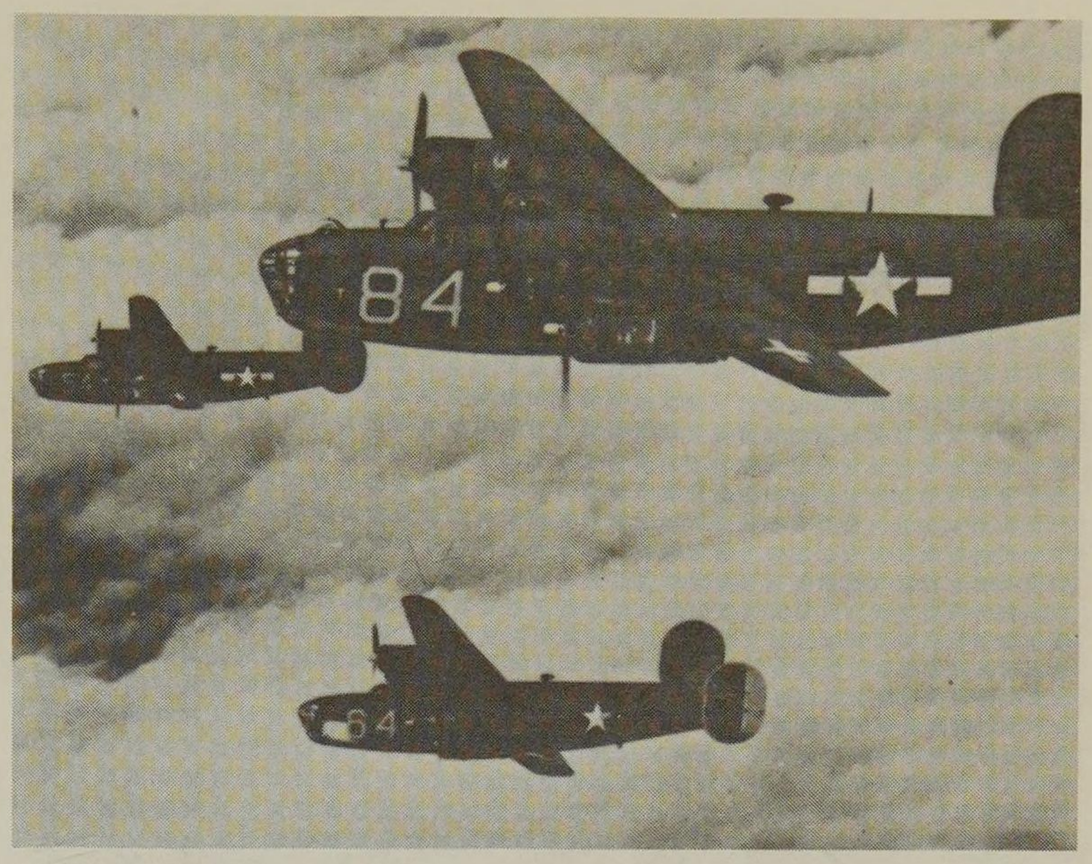
Back to the B-24. We trained in old D models and we used 91-octane fuel, which forced us to use lower power settings; but we operated at lower gross weights, never carrying anything heavier than 100-pound practice bombs. Still, we practiced every kind of mission, doing in relative safety all the things

we'd later do for real. By April we were a crew. The Army Air Forces now had the chore of getting us over enemy targets to carry out the primary mission.

During the first week in April, the appropriate authorities loaded us, the ready crews, onto a train and dropped us off in San Francisco, moving us next to Hamilton Field. Physical exams always came first at a new station. After that, we were sent to base operations, where we were assigned a new airplane. Go out to the Pea Patch, a remote ramp where the new airplanes were parked, and check out your new airplane, number 44-78192. Fly it locally for most of the day to see that everything works, concentrating on fuel consumption. Remember, it's your airplane now. Pride. The bird had no serious problems and was quite easy on the controls (a characteristic of the Douglas-built G models). "Now," said the operations office, "Go devastate the Bay Area night clubs, or vice versa. Be here at five o'clock day-after-tomorrow morning with all your baggage, for you are on your way to your combat organization." To the question about where, he advised that we'd be advised, little by little, as we worked our way along the Air Transport Command route, for we'd be under control of the Ferry Command, flying their visual-flight, daylight-only rules until we reached our destination. Obviously, we were headed out into the Pacific theater, Australia perhaps.

On the appointed day at the appointed time, the ten of us — as well as other crews departing that day — dragging our baggage, reported to base operations. The Ferry Command people were there to brief for this flight and provide a sealed envelope containing further orders. The sealed orders were to be opened when we were two hours out on our flight. In our case, Ferry Command assigned a puzzling destination — Sky Harbor Airport at Phoenix, Arizona, via airways. Our capable navigator worked up a flight plan as we leaned over his shoulder; the pilot worked on a clearance, the Ferry Command briefing team nodded smilingly at our papers and wished us a happy Easter egg, so we went to the Pea Patch, loaded up, started up, and departed on our odyssey.

Droning smoothly over the American Southwest two hours later, we opened our sealed orders. Fly to Morrison Field, near West Palm Beach, Florida, and report to Ferry Command briefers for further instructions. Our specific route was to Phoenix and RON (remain overnight), flying the next day to a base in Texas, Midland or Big Springs, and RON. The third day's flying was to Warner-Robins AAF Field, Georgia, proceeding the next day to Morrison Field, Florida. Not all airplanes flew this specific pattern, but several were flying the same flight plans each day. The Air Transport Command was set up to receive us, house us in their Hotel DeGink quarters — sometimes barracks, sometimes pyramidal squad tents, sometimes some pretty fair hotels once overseas. We could not really

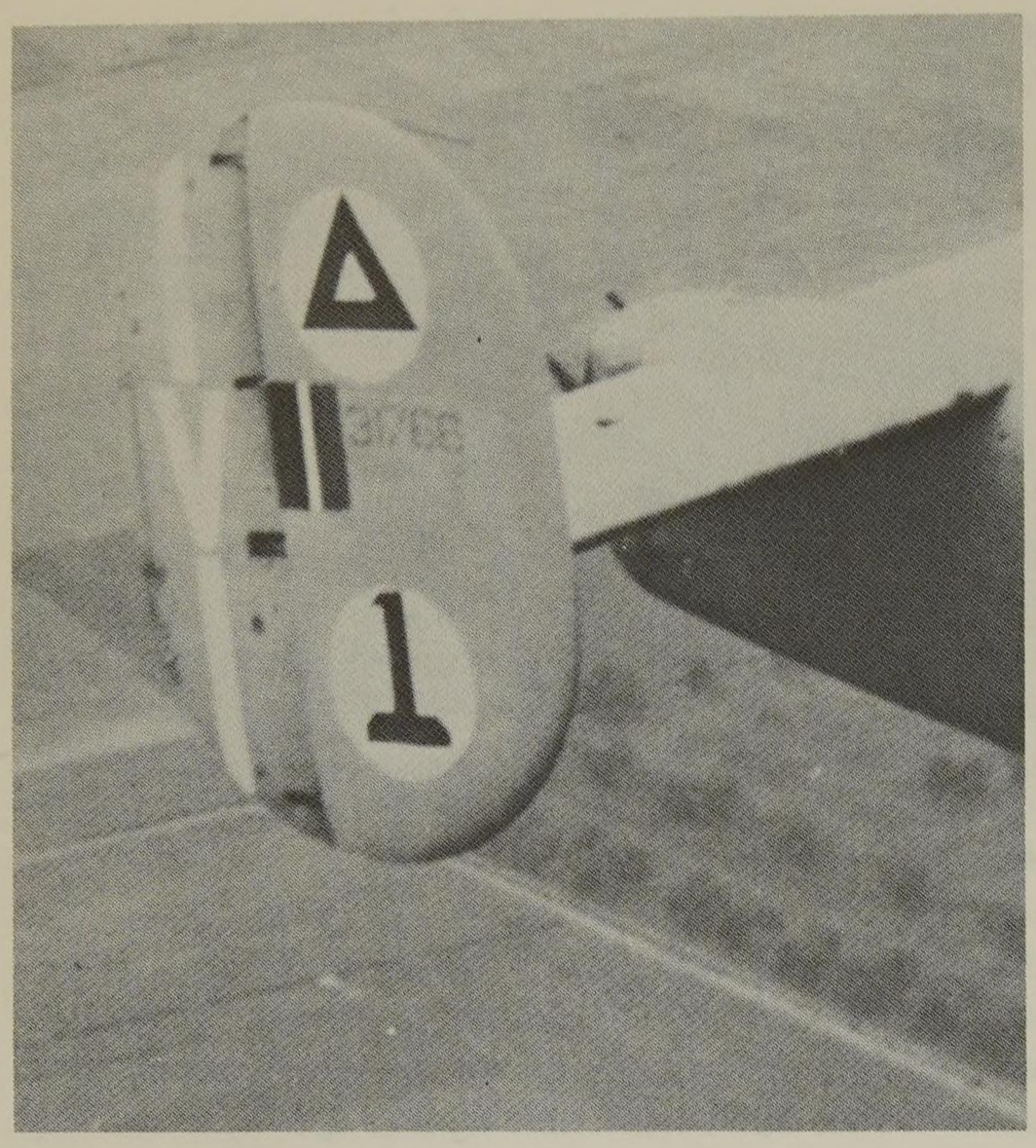


In formation.

complain about their mess halls, for they were always as good as we were used to. Not everyone was happy with the fact that at every stop we were restricted to the base. Better luck next time, girls. We were moving many crews in the early spring of 1944, so perhaps the restriction helped keep the size of the movement quiet. Personally, I felt we were a juggernaut the enemy could never even slow down, that we could with impunity sing the World War I song, "The Yanks Are Coming."

The authorities decreed a three- or four-day stop at Morrison, mainly, I believe, for a final stateside shakedown. Mostly it was hot in the temporary quarters, and boring. So we wrote letters, sweat from bare arms smudging some pages; perhaps the girls back home were able to translate the smudges to tearstains. At last, crews whose airplanes were ready were to do that five a.m. briefing. At operations we were told to prepare a flight plan to Borinquen Field, Puerto Rico, departing only if we could get there by noon. Any delay called for a departure the following day. We learned why. The days usually started in clear beauty, but massive thunderheads and attendant deteriorating weather set in by noon. (Ever since, I have found it wise to get the flight over early, which also helped the troops get an early start on the laugh-and-play activities.)

We also got a packet of sealed orders, to be opened two hours out. For heavy-bomber crews, the suspense was generally bearable: England or Italy. Our orders said we should report, at the end of the ferry line, to Gioia, Italy. Oh, joy. Well, somebody had to keep the valves closed on the Ploesti refineries. But the route to Italy brought most of us a heightened anticipation. From Borinquen we went to Waller Field, Trinidad, for some unscheduled supercharger maintenance — surging; nobody ever fixed it, but we learned to live with it. The next leg took us to Atkinson Field, British Guiana, later known for the deaths by self-poisoning of



some nine hundred religious cultists. All was quiet there then; in fact our leisurely afternoon at the pool was made memorable by a beautiful girl of mixed blood, striking enough for me to remember the sight for forty-odd years. Song of Solomon.

The early departure next day took us over unbroken jungle all the way, the only relief being the somewhat disconcerting one of having the compass wander rather aimlessly as we flew over the bauxite deposits in Dutch Guiana. We landed after having wondered for much of the last hour whether or not we'd wandered out to sea. The navigator knew it was only the estuary of the Amazon River. Further reassuring was the radio beacon from Belem, Brazil, which pointed forward to our day's destination. From Belem the following morning we returned to the jungle, flying across the equator to Fortaleza, Brazil, from whence we were to jump off to Africa. Again, a delay to shake down the bird for its transatlantic flight kept us there for two days. To divert us, the local people arranged a dance in a recreation hall on the base. As I was a poor dancer and absolutely without Portuguese (the language used in Brazil), the dance was a loser for me, except for a superior soft drink they served me. I believe it must have become the flavor base for a drink called Seven-Up.

Roughly half the crews took off across the Atlantic from Fortaleza; the others flew out of Natal. Again, a delay was offered to get the plane ready for its long overwater flight. Twin-engine planes went to a stop roughly half way across — Ascension Island. The mighty four-engine birds made a direct flight to Dakar, French West Africa, where gigantic Senegalese troops, barefooted and wearing brilliant, fire-engine-red fezzes, guarded the airplanes. The soldier guarding our airplane spoke good English and, on his time off, briefly showed me around the jungle, which began right behind our parked airplane. Having departed from Fortaleza in early evening to assure a daylight arrival in Dakar, crews had a day to catch up on missed sleep, then took off on a flight of great interest to me — across the Sahara Desert.

We took off and flew northward, climbing to an altitude of 9,000 feet as we neared the Sahara. Ahead lay a yellow, reddish-tinged sky, thick enough to reduce forward visibility to nearly zero. The dust seemed not to go much above us, so we elected not to use carburetor-air filters. The dust cloud seemed to retreat before us, a phenomenon observed with ordinary restrictions to visibility. But there was no restriction to vertical visibility. We saw the desert in detail. For me and all the crew, we saw a total desert for the first time. The desert in the American Southwest is a rain forest by comparison. Just as in the movies we'd seen as boys, the desert presented its spectacle of sand, smooth sometimes, in waves sometimes, in dunes a few feet high and dunes as high as low hills sometimes, but never anything except sand. No life was apparent there. And the sand appeared, occasionally, to roll on like an ocean, continuing for hundreds of miles.

The desert at last began to change to country like that in the southwestern United States. The Atlas Mountains rose to the north and west; we neared Marrakech, French Morocco, and the fantastic experience of the Sahara was behind, seen one time only by me, for I returned to the United States by another way. In the Western-style hotel in Marrakech, we drank white vermouth as Winston Churchill had done. There was nothing else to drink, and they served it in small water glasses, which was not so great for me, as I don't like that wine very much.

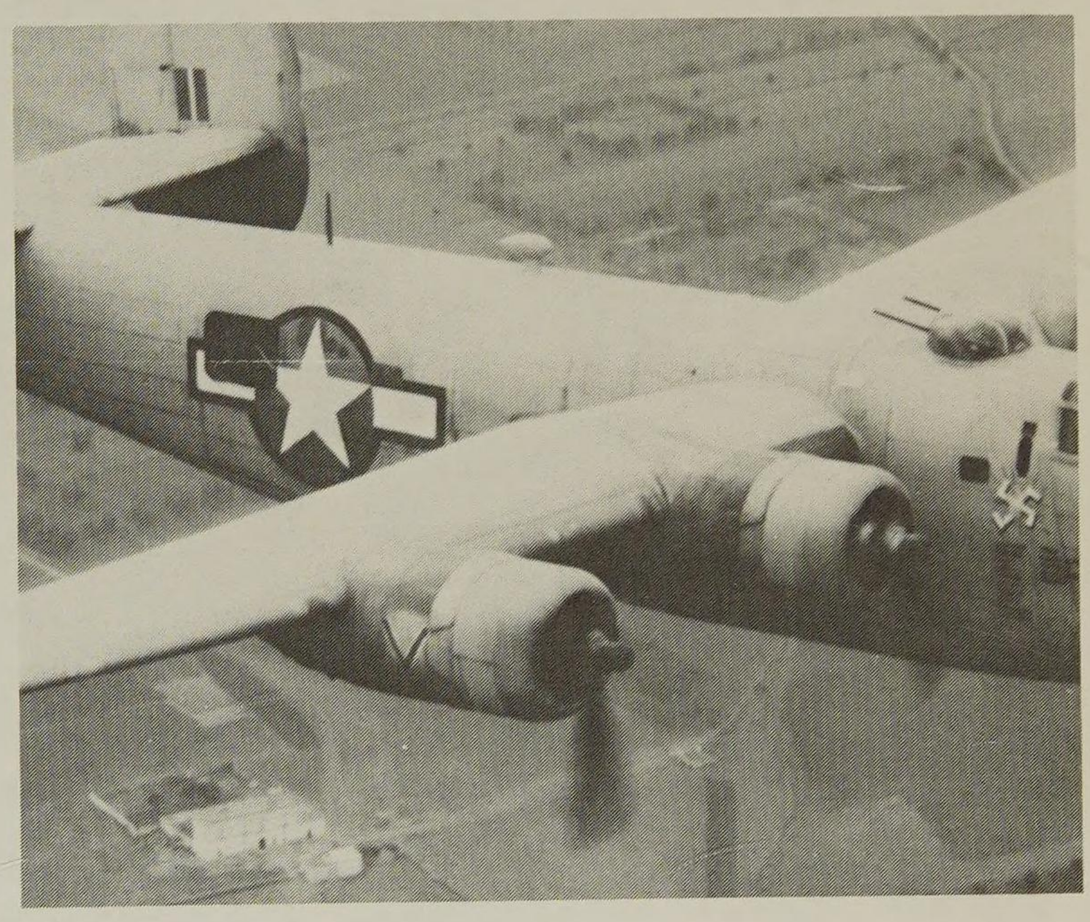
The pilot and I were too curious; we went to the Medina (Arab Quarter) from the European Quarter where we were staying. The Medina had a sort of deteriorating, head-high, adobe-brick wall surrounding it. Our taxi took us to a small gate; we entered and promptly lost ourselves. Fascinatingly different, the quarter was filled with curving, very narrow streets, through which one small vehicle could pass. The winding side streets, or alleys, were too narrow for automobiles, perhaps wide enough for one camel to pass through. Throngs of Arabs were everywhere; they silently made way for us to pass, then resumed their raucous conversations. We began to notice a group of young Arabs following us, and quickly recalled the reasons we'd been given for the Medina's being off-limits to American military people. Americans disappeared in there and were never seen again, though authorities sometimes recovered items of their clothing. We were wearing the prized leather flying jackets, which had not escaped the hot eyes of our would-be

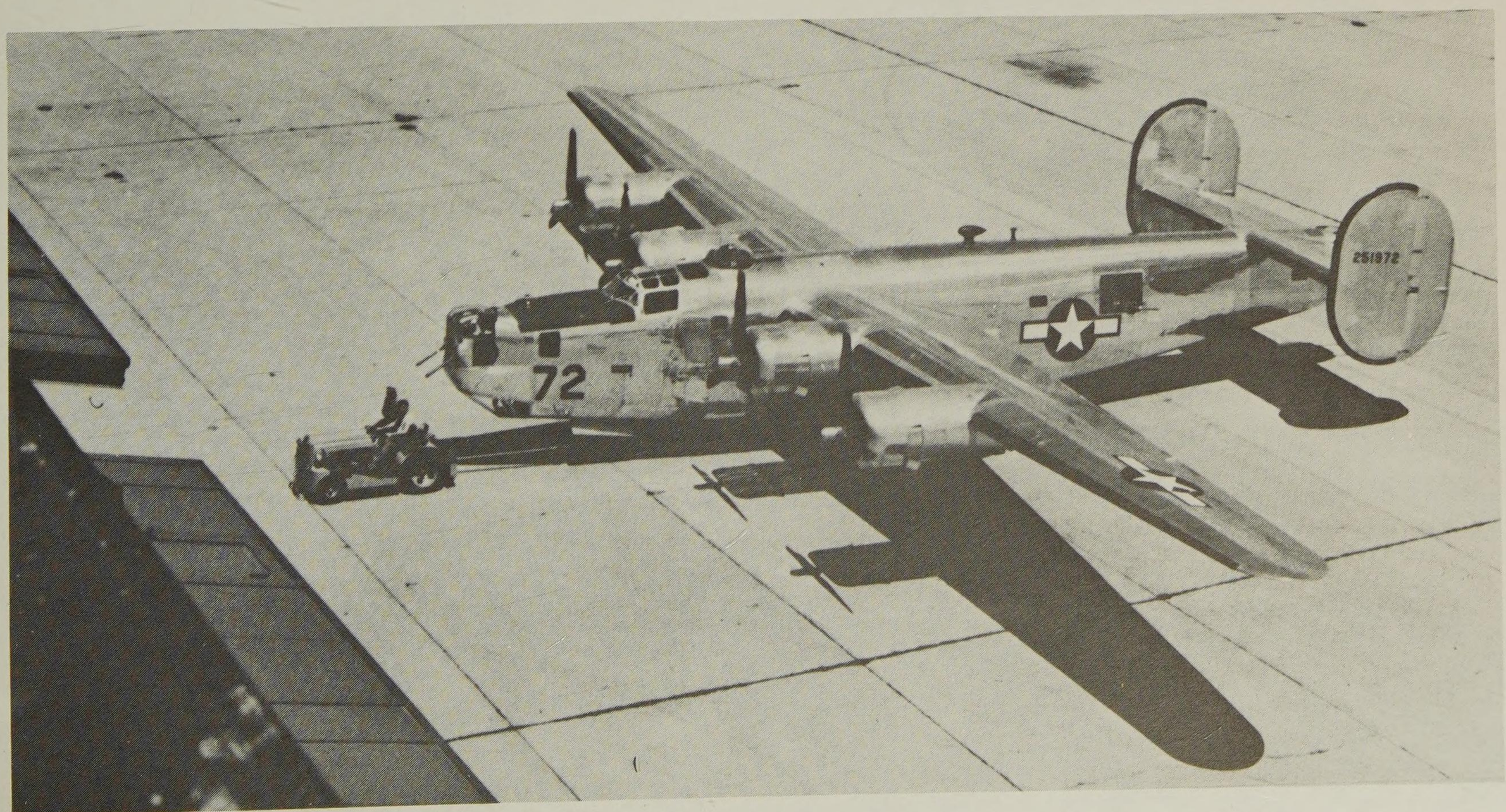
squad of executioners. We moved faster, since we didn't know where we were going, but the young Arabs kept pace. I thought how nice the vermouth would be now in the brightly lighted hotel bar. Altogether alarmed now, we chanced out onto a wider street crowded with camels and people and shops. Almost at once we saw a jeep with two military policemen in it. Happily, they arrested us for being off limits. Splendid. Happy ending today.

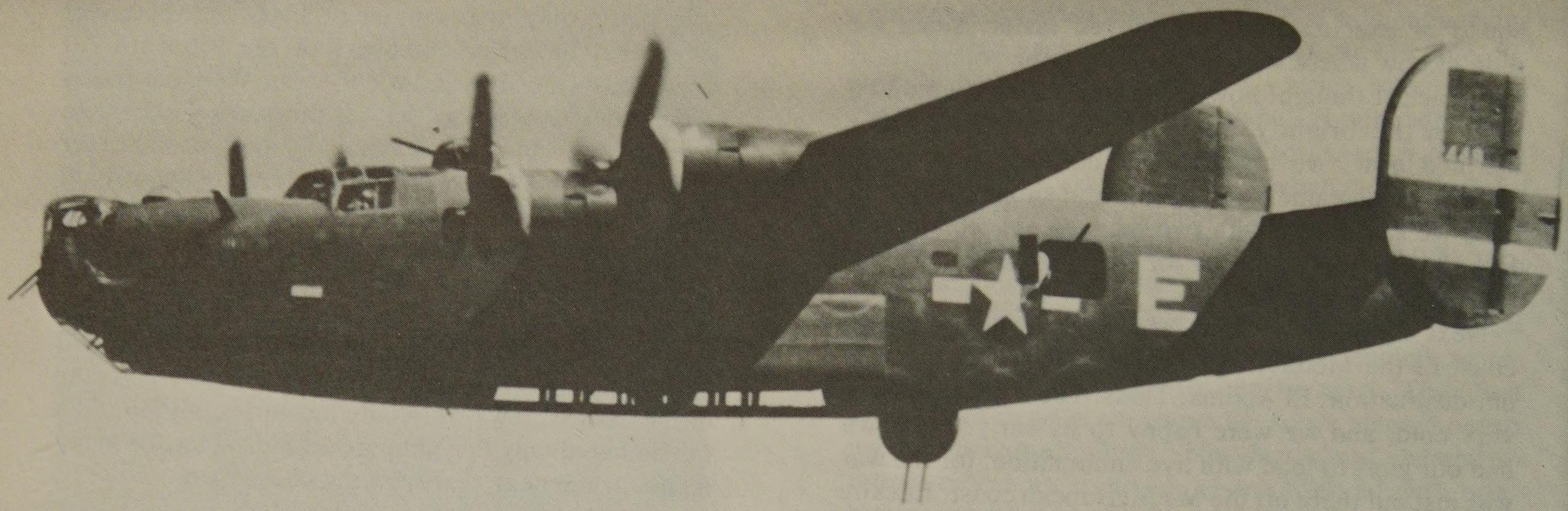
Next morning we flew eastward along the south coast of the Mediterranean, turning inland to land at our destination, El Aouina, Tunis. The April night was very cold, and we were happy to fly early. First, we had our guns to load with live ammunition, for the war was just out there off the Mediterranean coast. Luckily we didn't see any of it then, reaching our final ferrying destination, Gioia, Italy, where our airplane would be assigned to the organization most in need of a replacement bird. We as a crew would be assigned to the squadron most in need of a replacement crew. As it happened, a need existed for a crew *and* an airplane at a base near Cerignola; thus we didn't have to unload our luggage racks, which even contained my fly rod, until we reached our assigned squadron.

Nearly all replacement crews followed the just-described pipeline, or one that differed only slightly. The original groups to which we reported usually had trained as a group, had done their combat-phase training in the States, and had ferried their own planes overseas, some support troops crossing by water transport, an abominable way to go. I know for I had to do it myself later as a member of a group going overseas.

In that spring and summer of 1944, somebody decided that the heavy bombers of the Fifteenth Air Force must ride forth and win the war. Well, our losses were heavy enough so that all the souls assigned to combat crews saw that, statistically, they would never complete fifty missions. Fortunately, after Ploesti fell and the club officer was able to replace the glasses, which were all broken on that festive night, missions got easier. Some hard targets remained — synthetic oil plants and arms plants inside the tightened ring — but the new crews reporting in the fall of 1944 felt they'd make it through their missions. Many did, but so many of the earlier crews were only memories, all too often remembered only in nightmares. I myself awoke many nights of the next year with my cheeks wet.







AERIAL PHOTOS OF TARGETS

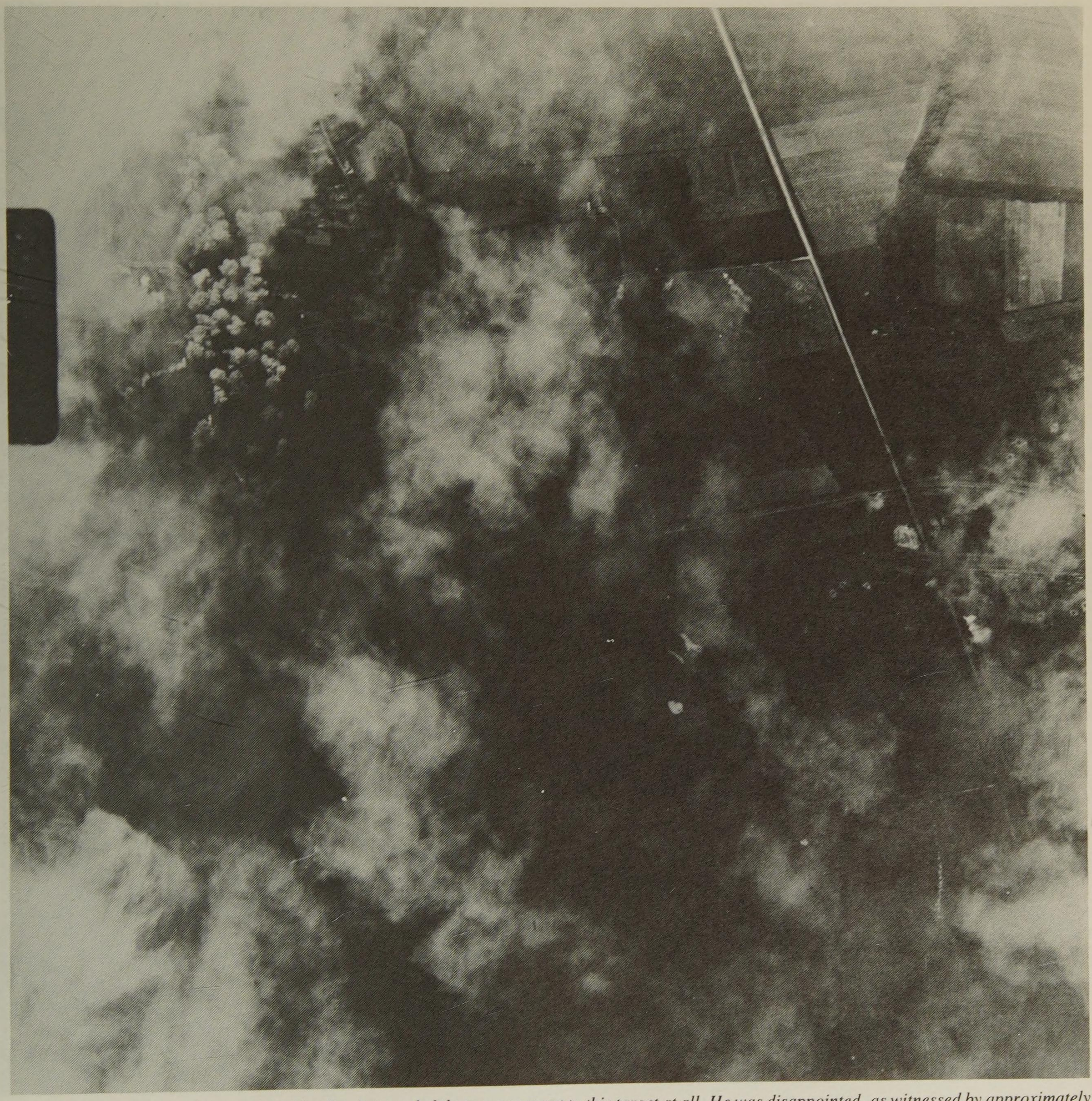
Some photos are for target identification, some are strike photos (usually of small strikes).

Original Air Force combat photos with wartime photo information. Above: bombs exploding in Munich, where operation was expensive. If one got shot down over Munich, he thought the target worse than Ploesti.

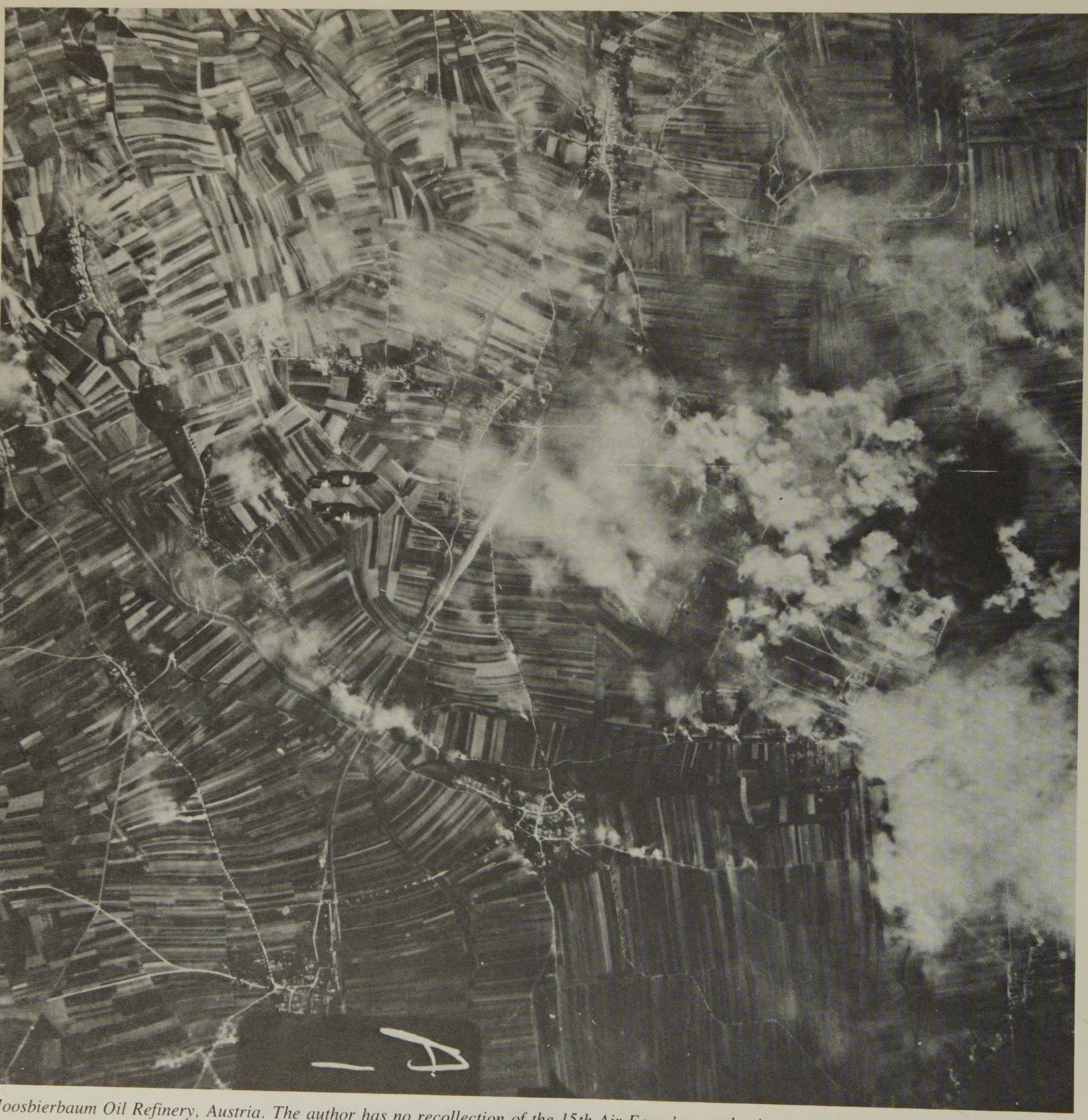
Piatra/Oltul RR Bridge, Rumania. Anything in Oil Country fascinated the brass, caused apprehension among the troops. Note bombs, perhaps 500-pounders, falling at low left of center (7 o'clock).

Same target as in AP I. (p. 80)

A stick of bombs falls, 12 o'clock high, on Aviso, Italy. The target is at 12 o'clock higher.



Ploesti, the grandfather of targets. Hitler firmly intended that we never get to this target at all. He was disappointed, as witnessed by approximately 300 bombers we left there.



Moosbierbaum Oil Refinery, Austria. The author has no recollection of the 15th Air Force's ever having to revisit this target.

Oradea Marshaling Yards, Rumania. Small strike, tight bombing pattern.

Montpelier RR Marshaling Yards, France. The Air Force was busy in France for more than a month before D-Day. Note the stick of bombs falling near the center of the photo.

9
Who Does What

The pilot is in charge of the airplane. Always. He cannot shift this duty, he cannot avoid this responsibility. The Air Force began, possibly to make the final responsibility clear, to call the pilot the Aircraft Commander. For some time one heard the term First Pilot, since there were two rated pilots aboard, sometimes more (in training, an Instructor Pilot was occasionally aboard, even with student pilots). During the war some popular man's magazine published a misconceived article called, as I remember, "Boss of the Bomber," which said that the flight engineer was in charge. Never at any moment was the flight engineer or the crew chief in charge. Some books suggest that the bombardier was in charge. Not ever, even when his bombsight was steering the airplane. The pilot always had, even on the bomb run, override control. The pilot is the aircraft commander.

Along about here, the pilot manuals get eloquent about this aircraft commander's responsibility for molding a crew, giving old truisms about leaving no weak links and about not being able to pass the buck. With a good head, an aircraft commander can build a good crew. Good men give the crew the best chance for being successful, and every man is important when the moment for him to do his thing comes along.

The aircraft commander has his best chance of building a supercrew if he knows his men, their strengths and weaknesses. As he gains this knowledge, he must practice his and the crew's techniques in doing the things they may one day face in a real situation. The commander, authorities agree, must know as much as possible about the job of each man -- how to determine the aircraft's position by shooting stars with a sextant; how to aim and drop bombs; how to fill the fuel tanks; how to send a message in Morse Code; how to hit a target with a .50 caliber flexible guns; how to operate the turrets. The aircraft commander must know how to conduct emergency drills, and he must conduct them. In short, he must know as much as possible about the duties of every crewman, a knowledge gained only by careful reading, by mentally running through the procedures, and by practicing them with the crew. Time. Work. Dare I mention the tiresome word leadership? That elusive quality comes partly from being able to develop each crewman's pride. No kidding — pride.

Every human wants to be a part of something, the philosophers say. I would add that he wants to be proud of that something. In this way the commander's job becomes easier. But the work of learning is there; the commander gets respect by knowing — and of course by example.

Say, commander, get yourself a book on leadership. Those books are all filled with sickening platitudes, but many of the things are true. You may remember something you could find useful. Then you'll find, someday, that leading doesn't mean following, or driving — ah, if we would all learn that in time.

All manuals have practical lists. Read, when possible, ignoring the extraneous and discarding the chaff if you can identify it. A later reading may suggest that some of that discarded chaff may really be of some substance. I can look back today at some simple advice, and I flood with shame at not having used it in some appropriate situation. My error was in not following the advice of someone who'd been there. Well, I'll give you some advice. Read and think, practice and teach, and don't brood too much over things you can't help.

The pilot's manual has a useful list for all seasons, "RULES TO BE ENFORCED ON EVERY FLIGHT BY THE AIRCRAFT COMMANDER."

1. Smoking
   a. No smoking in airplane at an altitude of less than 1000 feet.
   b. No smoking during fuel transfer.
   c. Never carry a lighted cigarette through the bomb bays.
   d. Never attempt to throw a lighted cigarette from the airplane. Put it out first. (Smoking was the macho thing in World War II, so the rules were needed.)
2. Parachutes
   a. All persons aboard will wear parachute harness at all times from takeoff to landing. (We used chest chutes almost exclusively; they had quick connects across the chest for almost instantaneous donning.)
   b. Each persons aboard will have a parachute on every flight.
3. Propellers
   a. No person will walk through propellers at any time whether they are turning or not.

b. No person will leave the airplane when propellers are turning unless personally ordered to do so by the aircraft commander. (I know of dogs and people who should have read this order.)

4. Oxygen masks

a. Oxygen masks will be carried on all day flights where altitude may exceed 10,000 feet and on all night flights, regardless of altitude. (The oxygen rule is much honored in the breach in these latter days.)

b. Day: all persons will use oxygen starting at 7,000 to 10,000 feet on all day flights where altitude will at any time exceed 10,000 feet.

c. Night: all persons will use oxygen from the ground up on all flights during which altitude may exceed 10,000 feet.

5. Training

a. Tell your crew the purpose of each mission and what you expect each to accomplish.

b. Keep the crew busy throughout the flight. (This strikes me as a hokey rule, making busywork, but here it is for elementary school teachers — idle hands, you know.)

c. Practice all emergency procedures at least once a week: bailout, ditching, and fire drill.

6. Inspections

a. Check your airplane with reference to the particular mission you are undertaking. *Check everything*.

b. Check your crew for equipment, preparedness, and understanding.

7. Interphone

a. Keep the interphone chattering. Ask for immediate reports of aircraft, planes, and ships, just as you would expect them in combat — with proper identification. (*Keep off the interphone. Keep it open for important messages from crewmen to crewmen.* I issued these firm instructions time after time. I had a talky boy on my crew who thought his jokes helped keep up crew morale on combat missions. "Keep off the interphone, Radio Operator. We use it for the flow of information needed on the mission.")

b. Require interphone reports every fifteen minutes from all crewmen when on oxygen.

Suggested Combat Crew Duty Assignments

Crews are built with the principle of interchangeability in mind. On short notice, a bombardier, for example, could fill in on any other B-24 crew. With standard crew duties, any crew member can be replaced on almost zero notice without jeopardizing the mission. A replacement, then, will be ready for standard duties as outlined below.

Pilot:
- Principal duty: Airplane commander
- Secondary duty: Pilot
- Added duty: Navigation specialist

Copilot:
- Principal duty: Assistant airplane commander
- Secondary duty: Airplane engineering officer & Assistant pilot
- Added duty: Fire officer
- Added duty: Navigational specialist
- Added duty: Gunfire control officer

Navigator:
- Principal duty: Navigator
- Secondary duty: Qualified as nose-turret gunner
- Added duty: Assistant bombardier
- Added duty: Oxygen and equipment officer
- Added duty: First-Aid specialist

Bombardier:
- Principal duty: Bombardier
- Secondary duty: Qualified as nose-turret gunner
- Added duty: Airplane armament officer
- Added duty: Ditching officer
- Added duty: Navigation specialist

Aerial engineer:
- Principal duty: Aerial engineer
- Secondary duty: Top-turret gunner
- Added duty: Qualified for copilot duties. Note: He is never qualified to fly the airplane, but knows the duties of assisting the pilot. In combat emergencies, the enginer has taken over the flying.
- Added duty: Parachute noncom
- Added duty: First-aid specialist
- Added duty: Assistant radio operator. (The navigator and bombardier both know Morse Code and might be more suited to handle the radios.)

Radio operator:
- Principal duty: Radio operator
- Secondary duty: Waist gunner
- Added duty: Assistant airplane engineer. (Prefer for this job the gunner with the most maintenance experience.)
- Added duty: First-aid specialist
- Added duty: Qualified as top-turret gunner

Nose-turret gunner:
- Principal duty: Nose-turret gunner
- Secondary duty: Turret specialist
- Added duty: Assistant to armament officer. (We titled him the Armorer in combat, where there was plenty of this critically important work.)

Belly-turret gunner:
- Principal duty: Belly-turret gunner (often called Ball-turret gunner)
- Secondary duty: Turret specialist
- Added duty: Assistant to ditching officer

Tail-turret gunner:
- Principal duty: Tail-turret gunner
- Secondary duty: Turret specialist
- Added duty: Assistant to parachute noncom

Every crewmember:
- Really becomes a first-aid specialist. Becomes proficient in every system he has time to learn.

Relative importance of crewmembers:

Every crewmember should, I believe, understand that he must perform effectively if the mission is to succeed. Every crewmember is needed, sometimes desperately. The mission cannot even start without the pilot and copilot. The navigator must provide the direction to and from the target. The bombardier becomes all important when the plane gets to the performance of its primary mission. Thus, every officer on the crew is indispensable.

The aerial engineer — the flight engineer — with his wide knowledge of the airplane ranks highest of the enlisted crew. The crew will not be successful without him. I believe I need him most because he is nearly always the most experienced man on the crew, and when he has this experience and knowledge I always develop affection and respect for him. Flying the B-24 becomes miserable work if you have a weak engineer. The radio operator and the gunners, for me, established their relative importance by the way they learned their duties and the airplane's systems. I remember all the good men with great fondness.

The most important characteristic of any crew member, certainly, is his courage. In combat, a man's willingness to do his duty in the face of those who do not wish him well is easy to understand as the most important quality he must exhibit. Difficult situations arise also when the enemy is far away; then guts or courage becomes the *sine qua non* for the men I want with me, or the men I want to be with. Fear is nothing more than awareness of the danger in any situation, and men with good heads are aware of it. But to stand with your cohorts and have them know you will carry your weight — that's where it is. Such men I want to be with forever.

We were assigned to the 737th Bombardment Squadron, 454th Bombardment Group, Fifteenth Air Force. The 454th was twice awarded a Distinguished Unit Citation; so if you were in this unit very long you could afterward wear that blue ribbon with the gold frame on your right breast; some time after the war, the Air Force moved the ribbon over to the left breast and gave it a ranking among the other decorations.

We fought the war in formation, almost without exception. Usually the whole Fifteenth Air Force flew as a unit in 500- or 1000-plane formations. The combat orders (frag orders to the groups) came from the Fifteenth, to the wings, and down to groups. At group headquarters, the basic preparation of battle orders occupied the staff most of the night, since the basic order usually arrived at group late at night. The only planning that group could do earlier was to decide which squadrons would provide what numbers of airplanes. The squadron commander decided on which crews would fly and in what positions and in what airplanes. Thus, the crews could go to squadron operations the night before a mission and find out whether they were scheduled to fly and which airplane they were assigned and where they'd fly in the scheduled formation. Crews didn't know the target until they learned at group briefing the next morning. Somehow, squadron people got some word on the target during the night. The bomb load had to be passed down as early as possible, for there was all that loading and fusing to do, and that may have helped squadron interpreters decide something about the target. Of course the specific target was secret until target time the next day, though after we achieved absolute air superiority the target got to be almost common knowledge. But all that squadron operations people would whisper was "looks like a big one" or a contemptuously muttered "milk run." But sometimes the target and bomb load changed late at night, so squadron operations types didn't know and could only look mysterious to avoid exposing the diminishing fact that they weren't *in* on the word. Axis Sally always knew, it seemed, and taunted us on radio; once in the air *we* always knew, so she didn't amaze us, though we sometimes wondered how *she* knew.

The commonest bomb load for heavy work during that spring and summer season in 1944 was 500-pound RDX bombs, and the peons carried ten or twelve of them. Leaders, I learned later, frequently had a lighter load so they'd be less likely to abort the mission if they ran into problems of maintenance or early battle damage. (Special fuses could reveal something about the mission, but I knew the mission only when told at mission briefing — then I'd know from the group "flimsy," which told everything). Occasionally, we'd carry 1000-pounders; sometimes 250-pounders. Other loads were less usual for us — fragmentation bombs in clusters, incendiary bombs in clusters. RDX bombs were fused nose and tail, for greater reliability, sometimes with instantaneous fuses, most often with short-delay fuses set for a small fraction of a second. Sometimes we carried some long-delay fuses in a load with mixed fusing. Once we tried acid fuses which, once armed, supposedly couldn't be de-fused, surprising the very hell out of Axis bomb sappers when they approached apparent duds. Oh, we were a fun-loving lot. The total load of RDX bombs usually added up to 5,000 pounds; with 2,000-pound bombs, of course, we carried 4,000-6,000 pounds, depending on the mission. With incendiary or fragmentation bombs, the bomb-loaders simply filled the bomb bays. The loaders safetied the fuses; after takeoff the bombardier and the armorer went to the bomb bay and armed the bombs by removing the safety wires from the fuses.

All this bomb-loading activity went on late at night or toward morning. Topping off fuel tanks went on shortly before crews arrived. Charging oxygen systems could be accomplished the afternoon before the mission, as could ammunition supply for the .50 caliber machine guns. Chaff (Christmas-tree tinsel to be dispensed by the waist gunners as the airplanes ap-

proached the target, and cut to certain lengths to confuse the German radar) cartons were usually stacked in the waist section the afternoon before.

Any observer could decide which airplanes were going on the mission by the steady activity around the planes involved, activity which commenced as soon as one day's returning crew parked the airplane on the hardstand. Work on battle damage and maintenance work started at once so the crew chief could make as early a determination as possible about the plane's availability for the next day's mission.

Combat bases were frequently temporary, and airplanes were parked on hardstands located just off taxiways in assigned squadron areas. A hardstand was usually constructed in a roughly circular form connected to the taxiway by a short throat of the same material as that of the hardstand and taxiway — in our case by compacted and slightly elevated earth and gravel, as were most of the Italian bases. The diameter of the hardstand was large enough to allow the B-24 to turn around on it. The throat of the hardstand was deep enough to allow airplanes to taxi by without threatening the nose of the bird parked there. Most of the time, the hardstand was bordered by RDX bombs of various weights; the bombs got there by late changes in bomb loads. Bomb-loaders arriving with the bombs for the new load simply kicked the existing load of bombs down off the bomb shackles (using screwdrivers to release the bombs, *after* removing the fuses and fins therefrom) and rolled the bombs off to the perimeter of the hardstand. They made convenient seats for the waiting aircrews, who calmly smoked and drank coffee in such close proximity to that RDX. (RDX was a powerful explosive which replaced general-purpose bombs sometime during War II. RDX exploded with a flash which seemed brighter than the sun, a blue-white flash too bright to look at from close on, as I observed one night when a combat-loaded airplane caught fire and gave us a complete demonstration, and on a later night when our bomb dump caught fire.

Also around the hardstand were a few 42-gallon oil drums, one for standing under the tail of the airplane to keep it from sitting down on its aft section — a combat-loaded B-24 was always so tail heavy that when the engines were shut down the old girl sighed and settled down on her tail, there to stay until she was started up again; if, as the aircraft was shut down, a ground crewman rushed in with an oil drum, the bird would sit on that and cause less disgrace to the whole community. Completely off the hardstand, maintenance stands stood ready to be pulled up to nacelles for ground-crew chores. Maintenance and servicing vehicles were usually standing by, but nothing the airplane wing wouldn't clear was ever left around for long. When the airplane was ready for operations, everything except the border of fuseless, finless bombs was cleared away.

All night long, aircraft engines sang, snorted, roared, and made lullabies for sleeping crewmen. All night long, service vehicles added their sounds. After awhile aircrewmen closed out these sounds, unless they were older crews who were going on the mission with the next light. But they, as a rule, didn't have too long to listen.

At a small hour — 2:00, 2:30 or 3:00 — the duty officer started his mufflerless jeep and made his round of the tents which sheltered the pilots on his list for wake-up. In Italy crews lived in pyramidal tents, the four officers in one tent, the six enlisted crew in another in a nearby area. The duty officer woke the pilot, who woke the other officers on his crew. Then the pilot washed his face in an inverted steel helmet filled with cold water, pulled on his clothes, and went to wake the flight engineer. The flight engineer, informed of briefing time by the pilot, woke the other five crewmen in the tent and herded them to the mess hall for breakfast. All ten crewmen dressed themselves and took everything they would carry on the mission, walking to the mess hall, which usually was framed tenting around a kitchen and a set of dining tables across a serving counter to each side of the kitchen — one side for officers, the other for the men. Crew usually sat together. Crew-hauling trucks shuttled from the mess halls to group headquarters, where the mission briefing would take place. All ten men gathered for the general briefing in a large tent or building. In the 454th, the briefing room was the basement of a large villa, where we sat on inverted bomb-fin cases of olive-drab color, the fin cases for 500-pound bombs being of just the right seat height. We waited for the scheduled briefing time, conjecturing about the target behind the veil over the screen; that veil covered the target, the route, and the defenses we'd encounter there.

At the appointed hour, the group commander strode in, followed by the briefing officers. All in the briefing room came to attention. The commander called "Seats" and announced the target, as an operations officer drew back the veil in front of the large map, on which a red ribbon showed the route to the target. Red greasepencil on a clear overlay showed the circle of antiaircraft guns and listed the total of guns, by type, we'd face on the mission. Following his remarks with a general statement about the purpose of the mission, the commander would turn the briefing over to the briefing officer, who, with his pointer, would call off the flak and possible fighters along the way; he'd give the IP (initial point from which the formation turned onto the bomb run), length of the bomb run, and the direction of the rally away from the target. Next he'd give the kinds of fighters and general numbers we could expect for penetration cover, target cover, and withdrawal cover. If the fighters were able to rendezvous properly, we'd have a wave of cover weaving overhead and to the sides all day. Early in the game, alas, the fighters

missed the rendezvous all too frequently, and we had the Luftwaffe for escort. As techniques got more practiced, our fighters were nearly always there and the Luftwaffe birds frequently were not.

On a display board to one side was a group formation with aircraft numbers and the last names of pilots listed. We didn't know many people in other squadrons, but we got familiar with the pilots' names. A flimsy, or fragmentary battle order, showed the formation and all the mission codes. A briefer handed out a flimsy to each pilot. The color codes for flares signaling important orders changed every half hour so it was practically impossible for the enemy to send false signals to which we'd respond. Radio silence was the order, but with all those airplanes and all those people in each plane whose radio-control box could accidentally be set on command position, thus transmitting to Europe, the airways were filled with transmissions. A saving factor, since we were on radio silence, was that we did not follow instructions which came over the air. Except for recall; and even then we peons simply followed our formation leader. Poor German intelligence people just couldn't tell what to believe.

Back to the briefing. The briefing officer read out the instructions on the pilot's flimsy, then turned the briefing over to other briefers. The weather officer gave a weather forecast and was followed by other special briefers, concluding with the chaplain's prayer for us. Then the operations officer called "Attention," and the group commander dismissed us to go to our specialized briefings. The navigators and bombardiers went to target briefing; the radio operator was briefed to be sure he had the correct periods of applicability for certain codes. The flight engineer and the gunners went to the airplane, often helping the refueling men top off the gas tanks, then securing and safetying the gas-tank caps. The pilots and copilots walked around to the front of the group headquarters and met the commander at the flagpole. There he gave us any special reminders, such as, "Long mission today. Keep the waist-window deflectors closed to save gas." He wished us good hunting (I never felt I was hunting — more likely hoping the Luftwaffe didn't find me.) He'd look up at the flag intently and then add the one command he had to make independently of all higher echelons of command: "Take off to the north."

The pilots would then go to the waiting trucks, give the squadron number to the driver, and climb into the bed of the truck. The next stop was at the squadron personal-equipment building, where appropriate pilots would alight and go pick up their parachutes and personal-equipment bag, checking everything to see that it was ready for the mission. Then back into a waiting truck, giving the driver an aircraft number. The driver would turn in at the specified hardstands; if he didn't turn in, the appropriate crew would remind him by beating on top of the cab.

The enlisted aircrewmen and the ground crewmen were already there; the navigator and bombardier frequently hadn't arrived from target briefing. The pilots would climb into the plane with their equipment and stow it in careful priority order behind their seats, climbing back down as soon as they'd had a preliminary look at the Form 1A to learn what to expect on the walkaround inspection.

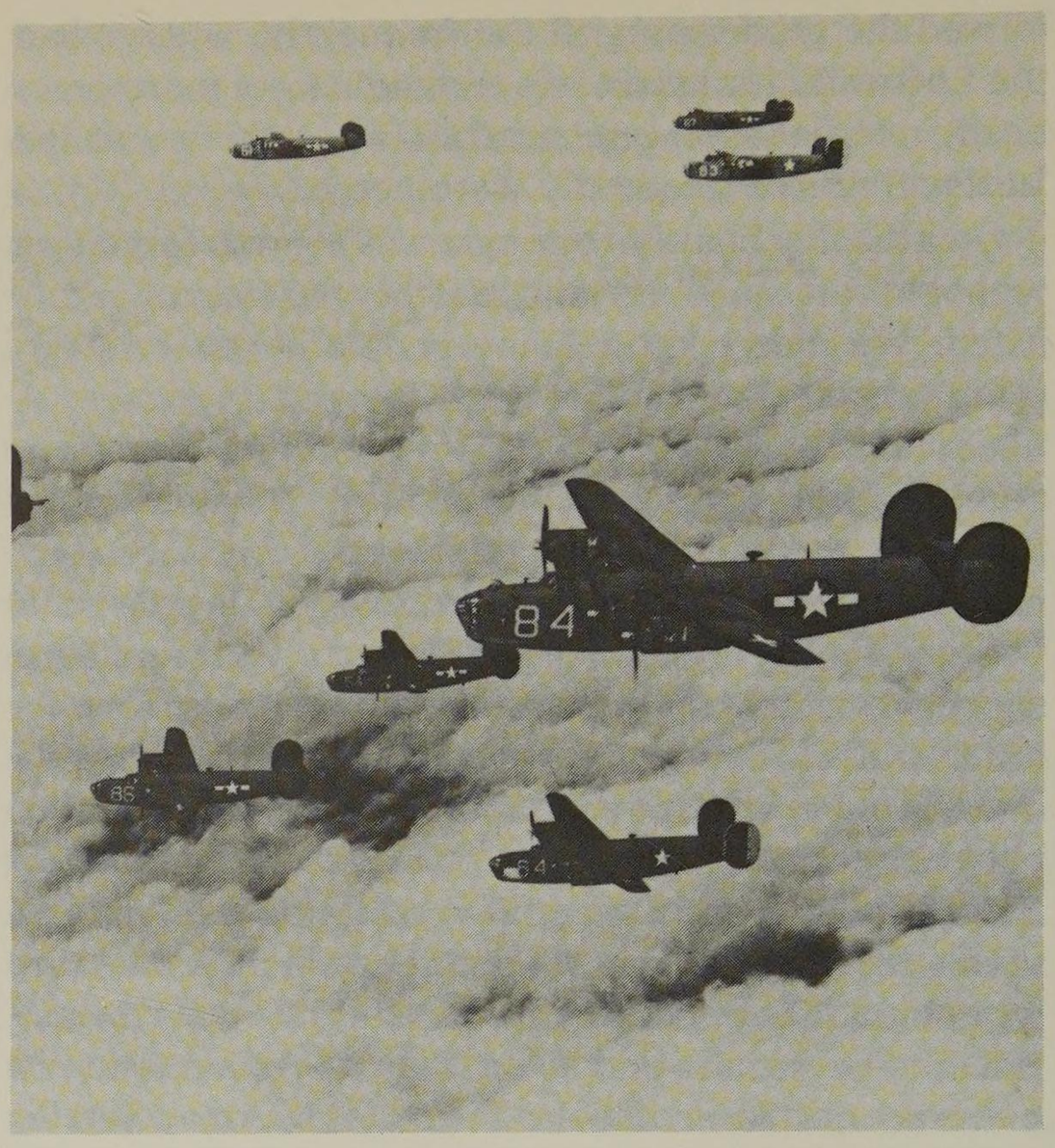
The amplified checklist discussed earlier covered crew procedure through a normal flight. A combat mission followed the same checklist activity, except that takeoff time for the group leader was precisely set. On usual days the leader made the schedule, and sat waiting, lined up on the runway for the signal to go. A green flare fired from a Very pistol at group headquarters signaled that the mission was on. A red flare meant stand down.

From the time of starting engines, pilots played sequences, or follow-the-leader. The exact times on the flimsy didn't mean much, except to provide general guidance. Pilots sat waiting, engines idling, looking at the flimsy to see which airplane to follow onto the taxiway. By the time the leader sat on the runway, most of the group airplanes were lined up on the taxiways. A control jeep sat beside the runway, on the left side where the commander could look directly at the pilot, waiting to give the clear-to-roll signal to the airplane lined up on the runway. At the prescribed minute, the squadron commander whose airplanes were taking off raised his arm and brought it down and forward along the line of the runway; this signal, sometimes made with a hand flag, also said the runway was clear, as on a dusty runway the pilot frequently could not see the far end. The pilot acknowledged the signal by extending his left hand to the open window and making a circle with his thumb and middle finger, and got a like signal of bon voyage from the clearing officer. Holding the brakes, the pilot advanced the throttles to about thirty inches of manifold pressure and released the brakes, at which time the aircraft lunged forward to get on with the day's work.

After takeoff, the pilot concentrated on getting into formation as rapidly as possible, which required turning inside the element leader, who was making a gentle turn to allow his followers to get into formation a bit more quickly. An organization slow to get into formation and join the larger formation slowed everything down. The group consisted of thirty or forty airplanes, sometimes forty-two, and joined its position in the wing at the designated rendezvous point. The wing then joined the line of wings and headed off climbing toward the target. When this gathering goes well, it is pleasant to watch. Occasionally, the sight nettles the more aware. That first lackadaisical pilot who stumbles along and delays the first element delays the whole Air Force. Good formations demand the thought and cooperation of every pilot, all the time.

Planning at every level must be careful and complete, and it begins with the individual crew member. Battles get terribly mixed up; confusion and indecision are everywhere. The side with the best planning and the best leaders will persevere and prevail, leaving the slovens in disarray and defeat. This ordinary pilot offers a grand-sounding opinion, but having observed military efforts in war and peace for my share of years, I believe fervently what I pronounce here. Only look back at a simple fishing trip when you didn't have your tackle carefully organized beforehand. As you stand in the cold wind and rain, knee deep in quicksand, you'll ruefully wish you'd planned your way out of this fine mess — even for a nimble-fingered girl to extricate you. So I recommend planning.

Formation flying you are already proficient in, even expert in, having learned swiftly as brutally demanded by combat situations. In training, formation was defined as two or more airplanes in the same quadrant of the sky and pointed in the same general direction. Sometimes the flyers weren't close enough to read the numbers of the other airplanes. German fighter pilots picked, I do believe, the sloppy formations to attack. Tight formations made tighter bomb-fall patterns, so you had to do your work fewer times, and you got back to those nimble-fingered girls sooner. If those aren't enough persuasive reasons, I'll fire you another opinion. I found good, close formation easier to fly. Heavy, heavy are the B-24's controls, times, say, ten hours from takeoff to peel off for landing, and you'll appreciate every foot-pound of energy you don't have to expend. Pack it in and get smooth on the controls — practice gets you so you don't have to jockey throttles, so you can take your hand off the throttles and fly with elevators alone. The closer you are to your lead plane, the easier it is to see when you are overrunning or falling back. With skill, you learn to hold position by slight rises and descents to maintain your position on the leader's wing. You can actually overlap the leader's wing as long as you maintain a vertical clearance, always flying slightly above the leader so that you can overrun without colliding. The man in the hole, however, simply flies below the lead, aligning himself with the leader's fuselage. He still maintains vertical clearance to avoid danger when he overruns — or here, underruns. As time passes when you're flying formation, you'll become steadily steadier at the technique and become always more contemptuous of those who can't catch on as rapidly as you. With acquired skill, you'll move steadily forward in positions assigned until you are flying the element leader's wing. Then when he gets shot down, you become the fearless leader, where the flying becomes easier and the promotions get harder to dodge. One more thing: as you get smoother, your fuel-consumption rate drops and you will probably get home. Inept flyers did run out of fuel and crash landed, sometimes in sight of home base.



But try to avoid getting assigned to the left wing of the leader; there you'll have to fly cross cockpit, which is an abomination. Stay on the right side of the leader and let your copilot fly cross cockpit, and what is worse, he'll have to crane his neck to look *down* cross cockpit at his lead, for the special fun of it.

One other comment. When the Luftwaffe appears, the need to urge close formation disappears altogether.

Another abomination, without which the Air Force could easily do, is echelon flying. Few are the excuses for it, except for the vanity of a commander who wants to impress the locals. That commander has never flown out a few numbers along the echelon, where you play at a vicious crack-the-whip. Fortunately, we flew that hateful echelon only once in my combat experience, that time fragging an airfield at Vienna. At all other times we flew a standard seven- or ten-ship box. In *Air Force Spoken Here,* James Parton's biography of General Ira Eaker, General Curtis E. LeMay is acknowledged as the man who developed the best combat formations for heavy bombardment. He settled on the six-ship box as the ideal. A good formation: all flyers could handle it without difficulty, and when the numbers of available bombers limited the size of the attack, perhaps it worked best. I came along later and was simply a line pilot, so my comments were not solicited, though they were freely given around the latrine and the club and wherever the flyers talked. A seventh ship at the tail of the box simply increased the tonnage. Then three more airplanes tacked on made a considerable increase in bomb tonnage and eased the demand for hot bomb-aimers. Whoever added to the LeMay prescription did well, I believe, without adding to the difficulty of the formation flying.

But with the fantastically more powerful bombs nowadays, perhaps the World War II prescription will not come again.

The Ten-ship Box Formation

```
      T
   T     T
      T
   T     T
      T
   T     T
      T
```

The ten-ship boxes favored by the Fifteenth Air Force saw no improvement while I was in Italy. In those critical days of the war, the ten-ship box satisfied the demand for squadron integrity, since one squadron could put up ten airplanes. One group could put up three or four boxes, and thus satisfy the absolute requirement for group integrity. The whole combat formation could form in trail, staggering assigned altitudes by group, going up and down by thousand-foot increments for a total variation of, say, three or four thousand feet, enough to keep the German antiaircraft fire directors at some uncertainty about our altitude. They couldn't just find us and keep pouring it to us at that altitude.

The whole group usually bombed on the lead ship's clue, thus using the best bombardier to give us our best chance at the highest effectiveness. The lead and deputy-lead bombardiers aimed at the target; all other crews dropped on the first bombs out of either of those two planes. The bombardiers in following planes had set their intervalometers as prescribed for the mission, then pushed the toggle switch when they saw the first bombs come out. To save bombardiers the danger of going on the mission at all, we led a toggle switch to the pilot's wheel and let the pilot toggle the bombs out when he saw the bombs from the lead ships start falling. The armorer knew the use of the screwdriver in case the bombs hung up.

The whole Fifteenth Air Force formation took two hours or more to fly over a target when all wings and all groups flew over in trail. People in the churches of Budapest, for instance, had to strain for an unbearable period of time to hear the service. Antiaircraft gunners, on the other hand, could do a lot of bracketing to find exactly where we were in the sky. To cure our objections about accurate flak, some Fifteenth Air Force operations-type ordered that we drive group formations across the target from all points of the compass at once. The drawbacks with this procedure became apparent as we crossed Vienna one fine Sunday morning from all directions. Quite dismaying to the combat crews was the sight of all these formations flying at each other from right, left, and front. More dismaying: the bombs falling from higher groups through the formations assigned to lower altitudes. Even Fifteenth operations people learned from the reports, from curses both loud and deep. Which proved that even operations people can learn, though they had forgotten the lessons of First Ploesti, when the forces found grief from flying both high and low formations without following the absolute demands of order and sequence.

The group, which put up three or four ten-ship boxes, frequently ordered them as one formation, again using only lead and deputy-lead bombardiers. The lead box set the direction, following in trail behind the group designated but always bombing independently. The second box flew high right, the third box flying low left. A fourth box flew in the hole.

```
                  T
               T     T
                  T
      T                     T
   T     T     T     T     T     T
      T        T        T        T
   T     T     T     T     T     T
      T        T        T        T
   T     T              T     T
      T                    T
                  T
               T     T
                  T
               T     T
                  T
```

Every position in the forty-ship group effort was relatively easy for pilots to fly. If any ship aborted, the formation simply closed up, so the Luftwaffe never found any ragged-looking formation to bounce.

In the early spring of 1944 when I joined my organization, we were using the standard of six seven-ship boxes for the group effort, setting the formation in two waves of three seven-ship boxes. A-box led, B-box was high right, and C-box was low left. D-box flew in the hole below and behind A-box; E-box flew high right in this second wave, and F-box flew low left. In plain view, an observer saw a flat formation. In the air, no airplane flew directly behind any other airplane; prop wash made the flat formation impossible. If the lead in D-box got too close to A-box, his wing men still had vertical clearance, thus greatly reducing the chance of collisions. In this two-wave, forty-two-ship formation, all bombs were dropped on the lead or deputy lead. The prescribers of this toggling-on-the-leader method recognized the delay in getting the whole group's stick of bombs out; thus the group leader aimed slightly short to make the main groups of bombs fall on the center of the target. We still had bombs from following planes going out quite late, so the pattern stretched to the

local village, or church, or hospital. Compound all this with heavy flak and terrified crews to make a very long pattern. Furthermore, bombs sometimes hung on the bomb shackles; the bombardier or armorer went back to the bomb bay and kicked out these bombs with a screwdriver. Any spot of grease at forty below zero congealed to the consistency of firewood, all too frequently causing the bomb to stick. Gremlins abounded in the super-frigid sky, causing strange electrical-current shorts that defied reasoning. Anyway, bombs fell long on nearly every target, so there were some wild tales in the Vienna woods.

May you always be absolutely elsewhere when the Americans bomb.

For whatever reasons the Fifteenth Air Force people had, we settled on the ten-ship boxes for squadrons, on thirty- or forty-ship formations for groups. For the probable reason that we got better bombing results, Fifteenth decreed longer bombing runs, which we flew without evasive action — in spite of the fantasies of *Catch-22*, a book written about the wrong war. But an initial point thirty miles from the target kept the bombardier from getting the target in the crosshairs of his sight. Slant-range visibility was almost always less than that distance, so the bombardier had to use some offset techniques to guess just where the target was. When the lead pilot turned at the initial point, just a turn to the predetermined heading into a haze was frustrating to the bombardier. In early days he appealed to the nose-turret gunner for help. If that eagle-eyed gunner could point his guns at the target he could ask for a course left or right to point the airplane right at the aiming point. This method, though helpful, worked imperfectly, sometimes for the reason that the gunner hadn't been to target briefing, hadn't studied the target, and was not as practiced as a navigator at finding landmarks. Somebody in a high enough position realized that we should carry a navigator in the nose turret. So decreed. Thus the bombardier had another little edge.

With the autopilot set up and the PDI (pilot's direction indicator) centered, the pilot could hand control of the airplane over to the bombardier for the bomb run. Working the crosshairs of the bombsight, he could change the course of the airplane. Some bombardiers preferred to leave the pilot with control. The pilot could center the PDI faster than the autopilot could, particularly in rough air, which accurate flak could cause. In any case, the pilot could override the bombardier on airplane control, at any time he thought necessary.

On the bomb run, the bombardier used the crosshairs of the bombsight to kill rate and drift. The rate is the speed at which the airplane is actually approaching the target; when the bombardier has adjusted the lateral crosshair so that the hair stays on the target, he has "killed" rate. When he has adjusted the vertical crosshair so that it stays on the line of the target, he has "killed" drift, which is simply the crosswind being encountered. With the crosshairs riding steadily on the target, he can, theoretically, take a nap. Something all too frequently changes: possibly the pilot doesn't keep the PDI precisely centered, or the wind changes, or the airspeed changes with anything that changes power. Sadly, the bombardier has to stay awake to keep the crosshairs centered. And because he has the altitude set in and the ballistics of the bombs set in, the bombs start out automatically when the appropriate release point arrives.

The pilot can feel it when the bombs go out, but the bombardier calls out on interphone anyway, "Bombs away."

The deputy leader also has his bombsight set up, but he doesn't kill drift unless he has to take over on the bomb run for a disabled leader. He kills rate, and if his bombs go out before the lead plane's bombs, the whole group toggles on that signal. The reason: sometimes the lead bombardiers bombs hang up; the deputy's bombs thus save the mission. In experience, the lead's bombs occasionally fell almost instantaneously, only a fraction of a second later.

During this critical phase of the bomb run, other events occur. The entire Third Reich put all it had on the line to prevent an orderly release of bombs. Such a defensive effort brought the Luftwaffe at us on the way in; then as we neared the line of coverage for anti-aircraft fire, the fighters withdrew to meet us on the other side of the flak shield. If our friendly fighters didn't make the rendezvous, the Luftwaffe made us long for P-38s, P-47s, or P-51s — or all of them. The 51s we thought of as fastest and the 47s as strongest, but we could identify the P-38s most easily. We sometimes confused the 51s with the German ME-109s, and the German FW-190 looked somewhat like the 47s. A dot in the sky closes fast, and excited gunners sometimes made imperfect identifications. We have been known to shoot down a friendly. I had a terrified tail gunner fire at a P-38. As always, he missed. Our own fighter pilots learned assiduously to avoid pointing their noses at bomber formations.

And now a note on gunners. I had only one gunner who shot down a German fighter. Most gunners had great troubles getting their guns pointed at the enemy; if they did, the guns malfunctioned or the bullets hit another American bomber. One day my tail gunner froze on the trigger (psychologically) while firing at an enemy and burned his guns out. With a beautiful chance at six FW-190s coming head on, a terrified nose-turret gunner abandoned his turret and tried to bail out. My steady bombardier restrained him physically, then invoked the aid of his .45 automatic. The poor gunner had to come all the way home with us. A pox on such gunners. But in their defense I must say that the weak ones all came to me from a broken crew

who'd gone through two forced landings, and whose pilot had declared fear-of-flying, an escape gate used all through the war. The squadron commander salvaged these gunners by assigning them to me. The only really good man in the lot, the waist gunner who shot down an FW-190, volunteered one morning to fly with another crew who at the last moment had to have a replacement gunner; Sergeant Hamilton would have finished his missions that day, but the airplane was lost with its entire crew. Somewhere it is written that only the good die young. That night at the club I peered into my brandy and recalled a line from Housman: Smart lad, to slip betimes away/From fields where glory does not stay.

Occasionally asked to talk to American Legion groups on Veteran's Day, I tell of a teenage nose gunner whose courage humbled me. He stayed in his turret even after flak had shattered the plexiglass, leaving him exposed for several hours to forty-below blasts. I saw the damage only when I was on the ground and asked him why the hell he'd stayed in the turret. His answer was that I'd said we needed every man on the team at his post.

Back to the bomb run. When the bombardier sang out a triumphant "Bombs Away!" the lead airplane turned to the designated heading for the rally away from the target at a specified airspeed, which was usually 170 mph. All men in the formation wanted to go faster to get out of the flak faster, but the crippled airplanes couldn't always go faster. The rally was usually a diving turn to get away from the altitude at which we were getting flak — a popular procedure. In my experience we usually dived away at 190 mph. After all, the hindmost could catch up as we burned the trail for home. I myself, one fine day, flying with one engine feathered, was left to catch up later. Unfortunately, a Luftwaffe group spied us, and suddenly I was up to my ass in FW-190s with the feared yellow rings around the nose cowling — Abbeville Kids. They clearly had very right to a victory over us; for whatever reason, they didn't make it. Using every inch of manifold pressure available, I steamed back into the formation and found them cruising along at 210 mph. They planned, perhaps, to wait for us at the bottom of the pool.

I was unwelcome back to the group that day because I brought in so many unfriendlies. Sorry about that, I later facetiously commented to the survivors.

Back at the beginning of the bomb run, masters of the B-24s always turned off the aircraft heaters, which ran on gasoline and added thus to the fire hazard. Then when we opened the bomb bays, we achieved instantaneously an inside temperature of forty degrees below zero Fahrenheit or Centigrade, take your choice. I always had, or thought I had, a busy time until our formation rallied off the target. At this point I always felt, suddenly, very cold. I discovered I'd been pouring sweat which had frozen my flying suit — pure unadulturated fear. Start the heaters? Fat chance up there where the oxygen was so thin. But our cup of thankfulness was running over, so who complained? The Italian sun would warm us later.

Always, on the way to the target, the heavy airplane felt heavy in my hands. Once clear of flak and on course for home, the big bird felt exceedingly light to my touch. The airplane, now without bombs and some 1500 gallons of fuel, actually weighed about 15,000 pounds less, and it was downhill all the way home. We pulled back that heavy power, went to auto-lean mixtures, and forgot all that heavy tonnage which had ridden our shoulders all the way to the target. Maybe there'd be another day after all.

In my group, we had an unmistakable landmark as we crossed the Adriatic: the spur of the Italian boot. We headed for that, for once we crossed the sea at the point, our base at San Giovanni (we usually thought Cerignola, a larger town, was our place, but historians made clear that the nearest town was San Giovanni) lay straight ahead. Our formation leader led us over the landing runway for our peel-off to the landing pattern.

If as individual aircraft we had no special problems, we simply landed in our turn, taxied by the welcoming committee at the large hardstand by the end of the runway, the pilot signaling a triumphant "all well" with his circle of left thumb and forefinger, three fingers flying like those of a Texas tea sipper, and continued to the assigned hardstand, where the faithful airplane got its chance to rest.

If, however, an airplane had wounded aboard, or desperate damage which would cause severe problems on landing — tire shot or hydraulic system out, for instance — the airplane fired a red flare to signal the condition. The red-red flare signaled both dire conditions. If the condition was wounded aboard, the airplane pulled off on the hardstand and crewmen brought down the wounded flyer(s). Waiting ambulances and chaplains went into action, and the unlucky airplane, once cleared of its wounded, taxied on. Groups returning from heavily defended targets provided a brisk business for the people waiting by the end of the runway.

If the problem involved aircraft battle damage only, the pilot moved out of formation as he approached the field and waited until other airplanes had landed and had cleared the runway. Thus, he didn't block the runway for the other planes, many of them getting perilously low on fuel.

At the hardstand the aircrew told the groundcrew about the airplane, including any bullet holes or flak holes, and flagged a passing truck for a ride to the personal-equipment shack. Stacking their equipment in their assigned bins, the crew then proceeded to the big deal — the mission drink. The flight surgeon sat at a small table, beside which sat a case of liquor (bonded

rye whiskey in our outfit) with an open bottle on the table and several glasses standing by. He had a list of the crews who'd made the mission, from which he'd call the pilot's name, and the crew would line up at the table. The doctor would pour a generous shot into a glass, checking off a name as each crewman took his glass. Some tossed off the shot directly; some carried it aside and drank off the rye in a more leisurely manner. If a crewman did not drink, he passed his glass to another member of the crew. The glass then went back onto the flight surgeon's table to await the next crew (the 100-proof contents had sterilized it). The flight surgeon, by this ritual, got to see and evaluate each man. As the missions piled up for crews, non drinkers always — *always* — became drinkers, to the unhappiness of those crewmen who'd up to then enjoyed an extra drink.

In this wise the flight surgeon got to know every combat flyer in the squadron. As a crew's missions accumulated, the doctor's hand got more generous. After my last mission, the old surgeon poured me two water glasses full of rye, which brightened my account of the mission for the group interrogation office. Nowadays, the Air Force calls the post-mission interrogation "debriefing." Endless progress. But interrogation was useful because it got into the record the fresh impressions of the air crew. Less admirable was the chance it gave gunners to claim the shooting down of enemy airplanes which they didn't shoot down. Public information officers loved to release the largest number of kills they could get anybody to testify to. There wouldn't have been any Luftwaffe left if gunners' claims were credited.

Hearing these outrageous claims always diminished me.

At group headquarters as we waited for a free interrogation officer, we had the pleasant experience of drinking Red Cross coffee and munching doughnuts, served from the hands of a lovely Red Cross girl. At least, the girls I saw were always fresh and pretty and smiling. After interrogation, crewmen climbed into the beds of waiting trucks for the ride back to the squadron area.

Routine with me was always pistol practice before I went to my tent and fell on my bunk. I had my Colt .45 automatic strapped on; a deep gravel pit lay at the end of our squadron tent row; I carried three clips of ammunition. So I and a few others who were good with the weapon had twenty-one rounds of target practice. One of my compatratiots later found his acquired markmanship useful as he successfully evaded the German SS troops who sought to capture him after he'd been shot down on a mission and had bailed out.

Down on my bunk for sweet sleep. Mission completed.

The missions always differed for me. Because of the tension involved, I never found a mission boring. I never looked forward to a mission but always was happy to complete one. After twenty-five missions, I spent a pleasant rest week on the isle of Capri. At the end of fifty missions, I spent three stimulating days in Rome. A few days later, I proceeded to Naples, where I boarded an army transport ship for New York and leave at home. All was pleasant except for the dreams, nightly at first but decreasing in frequency until they disappeared within the year. For some unfortunate men, the dreams never left them; for still fewer, the experience left permanent damage.

Two weeks at Miami Beach followed my home leave, after which I was assigned to Four-Engine Central Instructor's School at Smyrna Field, Tennessee. Flying that standardized course, I learned that the authorities had found out a lot about the B-24. In the spring of 1945 the powers who control such things took away our B-24s and replaced them with brand new B-17s. Having never flown the B-17 before, I found the transition phase interesting, mainly because it cleared up hangar reports and propaganda about the planes.

World War II ended with the sudden onset of the Atomic Age. I later went to the B-29, while the remainder of the Air Force went pell mell into the jet age.

The B-24s were all scrapped in short order, but they still have a central place in my affections.

Appendix A
General Specifications For The B-24

If you approach a large airfield and see a big, roundish, overweight-looking airplane struggling to get into the sky, don't laugh. If it has four air-cooled, radial engines, and the main wheels are coming up one ahead of the other by spells, each pointed outward, try not to smile. You may be in the twilight zone; you may be watching a World War II air show; your steel-trap mind will tell you the airplane is a B-24 Liberator, a midwing, land, twin-tailed, heavy-bombardment airplane headed for a place where it is more admired — overhead.

If you drive onto the field and see a tricycle-landing-geared airplane with its aft section sitting on the ground or on an oil drum, with its nose wheel up in the air, it is a combat-configured Liberator, designed and first built by Consolidated Aircraft Company, later also built by Ford and Douglas. Don't look pityingly at her, for her place is in the sky, where you can see her grace, where she outperformed any other bomber until the B-29 came into operation.

When the war was over, you simply had to avert your eyes from the mass slaughter of these unwanted ladies. They did them all in, faster than men with clubs going after baby harp seals on an ice floe.

These aforementioned airplane-makers flooded the sky with 18,000 of these Liberators. As they rolled off the line and joined the Air Corps, they had a basic weight of 36,000 pounds, a maximum gross weight of 65,000 pounds. If you flew her fast, 355 mph was an excellent place to stop increasing her speed; point her down and she'd go past that limitation fast, but you couldn't be confident that all her bits and pieces would stay attached. At maximum gross weight, knowing people said to limit her top indicated airspeed at 275 mph.

DIMENSIONS

A. Airplane — General
- Fuselage height ..... 10'5''
- Overall span ..... 110'0''
- Overall length ..... 67'2''
- Overall height ..... 17'11''
- Clearance, inboard propeller tip to ground .. 2'10-1/2''
- Clearance, outboard propeller tip to ground .. 3'3-1/2''
- Clearance, propeller tip to fuselage ..... 1'9''
- Clearance, inboard to outboard propeller tips .... 2'6''
- Clearance, propeller to wing leading edge ... 6'2-1/16''
- Clearance, bottom of fuselage to ground ..... 1'8''

B. Wings
- Root chord ..... 14'0''
- Dihedral ..... 3 degrees 26''
- Incidence ..... 3 degrees 0''
- Sweep — leading edge ..... 3 degrees 20''
- Total wing area (including ailerons) ..... 1048 sq. ft.

C. Flaps
- Area (total) ..... 144.1 sq. ft.
- Chord (maximum) ..... 2'7-7/16''
- Movement of flaps (maximum down) ..... 40 degrees

D. Ailerons
- Total area (each) ..... 41.55 sq. ft.
- Movement of aileron, up ..... 20 degrees
- Movement of aileron, down ..... 20 degrees
- Area of aileron tab (right aileron) ..... 2.52 sq. ft.
- Movement of tab, up ..... 10 degrees
- Movement of tab, down ..... 10 degrees

E. Tail Group
- (1) Horizontal stabilizer
- Overall span ..... 26'0''
- Total area ..... 140.54 sq. ft.
- (2) Elevators
- Total area ..... 60.06 sq. ft.
- Movement of elevator, up ..... 30 degrees
- Movement of elevator, down ..... 20 degrees
- Area of elevator tab (both) ..... 2.40 sq. ft.
- Movement of tab, up ..... 10 degrees
- Movement of tab, down ..... 10 degrees
- (3) Vertical fins
- Area (both) ..... 139.0 sq. ft.
- (4) Rudders
- Total area (both) ..... 65.0 sq. ft.
- Movement (to each side) ..... 20 degrees
- Area of rudder tabs (both) ..... 1.92 sq. ft.
- Movement of tab (each side) ..... 10 degrees

F. Landing Gear, Tricycle
- Tread ..... 25'7-1/2''

Wheel base (fore and aft) ..... 16'0''
Gear consists of two main wheels and a nose wheel, mounted on air-oil shock struts.

EQUIPMENT AND SYSTEMS

A. Engines

Four Pratt & Whitney 14-cylinder, twin-row radial, air-cooled engines, R-1830-43 or R-1830-65, with internal single-stage, single-speed, engine-driven integral superchargers. Engines are rated to produce up to a total of 4800 horsepower using grade 100 fuel and takeoff power settings.

Each of the engines is equipped with a turbo-supercharger to furnish compressed air to the fuel-induction system.

B. Propellers

The three-bladed propellers are Hamilton Standard, hydromatic, full-feathering, controllable-pitch, constant-speed. Toggle switches on the pilot's pedestal electrically control the governors, which maintain the constant-speed feature. The four tachometers show propeller revolutions per minute. Propeller gear ratio 16:7. To operate the B-24 safely it is all important for the pilots to understand the principle of the constant-speed propeller, its relationship to engine pressures (manifold pressure and brake mean effective pressure) and to know when to and when not to use the feathering feature. Manifold pressure is the power compressed in the intake manifold, and it thus provides more expansion (more power) upon ignition in the cylinder, just as the compressor in a jet engine compresses air to expand more powerfully once mixed with fuel and ignited in the burning cans. Full feathering is the turning of the propeller blade's edges directly into the wind, fully stopping the blades from turning in the windstream and causing the minimum drag on the airplane. The stopping of the engine's rotation also saves the engine from internal disintegration. You can easily imagine further unspeakable developments resulting from failure of a dead engine to stop turning in the airstream, or, in other words, windmilling.

Brake Mean Effective Pressure (BMEP) is the average pressure within the cylinder of an engine during the power stroke of the piston. As the pressure within the cylinder is increased, more heat is developed because of the energy of compression. If the pressure and temperature increase sufficiently, detonation occurs. And worse — cylinder heads blow open.

C. The Davis Wing

The B-24 wing is an internally braced, skin-stressed type, tapered, with a high aspect ratio. Considered one of the most efficient airfoils ever developed, the Davis wing was a radical departure from airfoils in use when the Liberator was designed. Its unusual efficiency accounts for the combination of high speed, long range, and great load-carrying qualities of the airplane. Flaps greatly vary the lift-drag characteristics of the wing, as is evidenced by the facts that normal takeoffs are made with 20 degrees of flaps, that maximum lift and stability at slow cruising speeds can be obtained with 5 to 9 degrees of flaps, and that 10, 20, and 40 degrees of flaps effect successively larger reductions in stalling speeds.

D. Wing Flaps

The all-metal Fowler-type wing flaps retract into the wing center-section trailing-edge wells. Maximum down travel is 40 degrees.

E. Ignition

Engine ignition is provided by two American Bosch magnetos, mounted on the rear section of each engine. Separate switches permit either one or both magnetos to be operated on the engine. Battery switches are on the copilot's auxiliary switch panel. A master-switch bar located just above the magneto switches is available for simultaneously shorting the primaries of all magnetos and for opening the battery circuit of the main electrical system.

F. Cowl Flaps

Engine cooling is regulated by means of adjustable cowl flaps, which are controlled electrically from the pilot's pedestal. The range of cowl flap control is from closed to 12-1/2 degrees to 30 degrees open, depending on the model airplane.

G. Carburetors

Early airplanes (up to #42-41115) were equipped with Bendix-Stromberg carburetors. Later airplanes had Chandler-Evans (Ceco) carburetors.

H. Control Surfaces

Rudders, elevators, and ailerons are equipped with trim tabs (except left aileron) and are fabric-covered; all other surfaces are metal-covered.

* * *

In addition to its propeller, each engine drives some major units.

No. 1	No. 2	No. 3	No. 4
Electric Generator	Electric Generator	Electric Generator	Electric Generator
2 Magnetos	2 Magnetos	2 Magnetos	2 Magnetos
Fuel Pump	Fuel Pump	Fuel Pump	Fuel Pump
Turbo-supercharger	Turbo-supercharger	Turbo-supercharger	Turbo-supercharger
Vacuum Pump	Vacuum Pump	Hydraulic Pump	Vacuum Pump

Appendix B
Pilot's Checklist

Before the checklist, which properly starts when the pilot, copilot, and engineer are in position in the airplane, all individuals make preparations for the coming flight, beginning with group or squadron briefing. Each man picks up, inspects, and takes his own personal equipment to the airplane and stows it in his crew position. Then each crewman inspects the aircraft equipment he will be using on the mission and goes back outside for a crew meeting, where the aircraft commander usually questions the crew about personal readiness and equipment readiness — turrets, guns, ammunition, bombs, fuses, and the like — before any special crew briefing. In good organizations and on routine days, everything is completed well before the time for starting engines. Nearly always, in addition to ground-crew inspections, three members of the flight crew — pilot, copilot, and engineer — make external aircraft examinations, sometimes known as walk-around inspections. Then the aircraft commander looks at his watch and says, "Let's go," or the John Wayne order, "Let's saddle up," at which time aircrewmen board the airplane, making another internal inspection of their particular areas.

As the aircraft commander I have already stowed my personal equipment behind my seat in a standard order in my parachute bag, starting from the bottom with heavy jacket for high altitude, fleece-lined helmet with oxygen mask attached, pistol with loaded clip inserted, belt with two extra loaded clips (combat missions only), lucky rag doll (you know, to make sure I get back from the mission), light and heavy gloves, chest parachute (I'm already wearing the harness over my A-2 leather flying jacket and Mae West — if over water — and also have on my fleece-lined boots if we are going to altitude), and personal fire axe on top.

I sit down in my seat and adjust it for height and distance from the rudder pedals so as to have easy, full travel on them and full control on the brake pedals, which are the top sections of the rudder pedals. Here I make sure the rudder adjustment catches are securely relocked. Imagine the trouble slippage causes when you need heavy pressure and find the catches not locked. I also check to make sure all the controls I'll need to use are in easy reach. Now I adjust my safety belt and fasten it, thrusting my weight against it to check its secureness. When you do any of these apparently minor things carelessly — or fail to do any — THEY CHEER, *they* being Hitler, Mussolini, and Tojo as shown on the numerous flight-safety posters located all along the flight line. I, needless to say, never wanted them to cheer, and didn't even want to amuse them.

Now I take my checklist in hand and call "Checklist." The copilot takes his checklist and reads every item in order, crisply and clearly. Whichever person accomplishes the action responds in the same clear manner with the exact words specified. In case you haven't ever seen a B-24 checklist, it is a 5-by-8-inch, double-weight card printed on both sides. This, as with your American Express Card, you never fly without. I follow each item carefully to make sure the copilot doesn't miss an item. All of us move along at careful speed, for there are many items to check. The abbreviated checklist follows, in single-column format. Usually, printed cards are in double columns.

AAF OFFICIAL CHECKLIST
B-24, D, E, G, H, & J

BEFORE STARTING ENGINES

- 1. Form 1A — Checked
- 2. Loading — Checked
- 3. Wheel chocks — In place
- 4. Pitot covers — Removed
- 5. Gas tank caps — Checked
- 6. Flight controls — Checked
- 7. Fuel tank valves and amount — Checked
- 8. Generators — Off
- 9. Carburetor air filters — As required
-10. Main line and battery selectors — On
-11. Auxiliary power unit and hyd. pump — On
-12. Brake press. and parking brake — On
-13. Gyros — Uncaged
-14. Autopilot — Off
-15. Superchargers — Off
-16. Props — High rpm
-17. AC power switch — On
-18. Intercoolers — Open
-19. Pitot heater — Checked
-20. Cowl flaps — Open

-21. Mixtures — Idle cut-off
-22. Wing flaps — Up
-23. Wing de-icers; prop and carb. anti-icers — Off

START ENGINES
- 1. Call clear, fire guard — Posted
- 2. Ignition switches — On
- 3. Throttles — Cracked
- 4. Booster pump — On
- 5. Start engines — Check oil pressure
- 6. Flight indicator — Check righting

BEFORE TAXYING
- 1. All instruments — Checked
- 2. Vacuum — Checked (both)
- 3. Radio, altimeter, and time — Checked
- 4. Alarm bell — Checked
- 5. Wheel chocks — Removed

BEFORE TAKEOFF
- 1.* Trim tabs — Set for takeoff
- 2.* Mixtures — Auto-rich
- 3. Exercise props, supercharger, and flaps
- 4. Props — High rpm
- 5. Run up engines
- 6.* Superchargers — Set and locked
- 7.* Gryos — Set and uncaged
- 8.* Wing flaps — 20 degrees
- 9.* Flight controls — Checked
-10.* Doors and hatches — Closed
-11.* Aux. hyd. pump and power unit — Off (more on this)
-12.* Generators — As required
-13.* Cowl flaps — Trail
-14.* Booster pumps — On

AFTER TAKEOFF
- 1. Wheels — Up (brakes applied)
- 2. Superchargers — Set for climb
- 3. Throttles — Set for climb
- 4. Props — 2550 rpm
- 5. Wing flaps — Up
- 6. Booster pumps — Off
- 7. Cowl flaps — As required

BEFORE LANDING
- 1. Altimeter — Checked
- 2.* Crew to stations — (nose clear)
- 3.* Auxiliary hydraulic pump — On
- 4.* Brake press. and parking brake — Check and off
- 5. Autopilot — Off
- 6.* Gear handle — Down
- 7.* Mixtures — Auto-rich
- 8.* Props — 2400 rpm
- 9. Intercoolers — Open
-10.* Cowl flaps — As required
-11.* Booster pumps — On
-12. Wing de-icers — Off
-13.* Wheels — Checked, light on, handle neutral
-14. Ball turret and trailing antenna — Retracted
-15. Wing flaps — 10 degrees

D 790 .C27 1988 91-11241

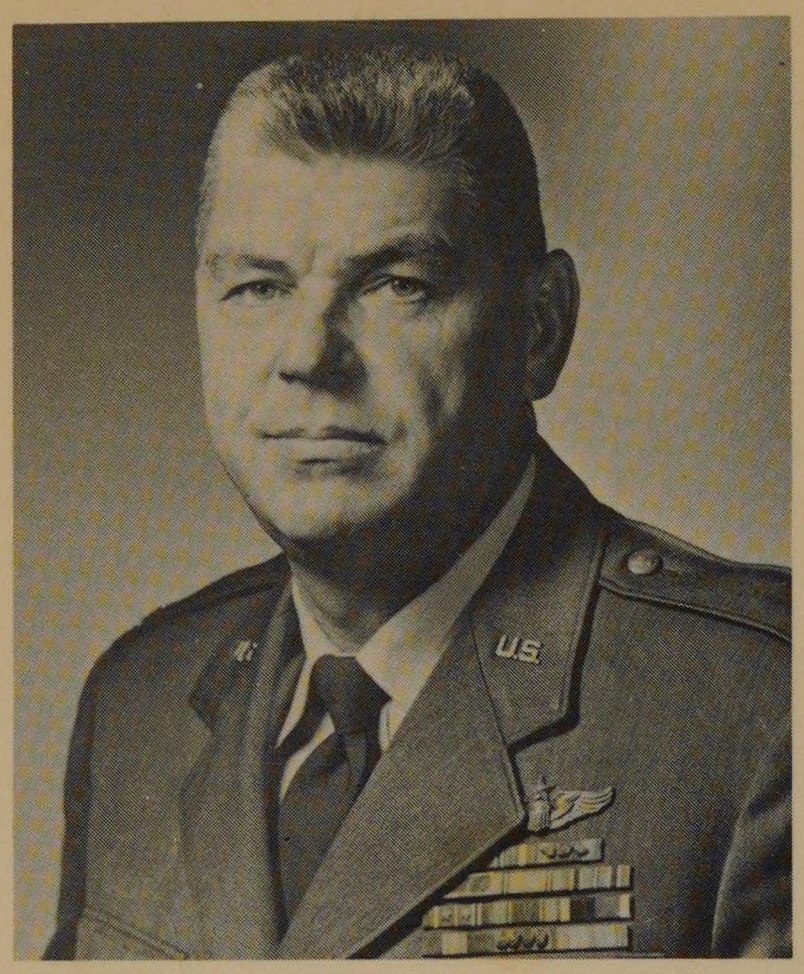
Carigan, William.

Ad lib

SOUTHEASTERN OHIO REGIONAL LIBRARY
40780 STATE ROUTE 821
CALDWELL, OHIO 43724

DEMCO

EGIONAL LIBRARY
3 3501 00010 3885



The late William Everett Carigan, Jr., was born in Kentucky in 1919. He attended the University of Kentucky and Union College and in 1939 joined the Kentucky National Guard. In January 1941 he was mobilized as a private in the Quartermaster Regiment of the 38th Infantry Division. In January 1942 he was commissioned a second lieutenant, after attending Quartermaster Officers School. He applied for pilot training as a first lieutenant and started flying school in February 1943, winning his wings in December 1943.

Assigned to a copilot slot in B-24s, Carigan was sent to Edwards Air Force Base (then Muroc) for combat phase training. In April 1944, he went overseas, flying a new B-24 to Italy and the Fifteenth Air Force. After flying 50 missions, he was returned to Smyrna Army Air Field, Tennessee, in January 1945 for Central Instructors School, which he completed in April 1945.

Carigan flew a short while as a B-24 instructor pilot, but when the B-24s were replaced by B-17s in the early summer of 1945, he became a B-17 instructor.

After the war he was assigned to base supply where flying was secondary.

During the Korean War, Carigan was assigned to a fighter-bomber wing and spent three years in England. He later served in the Pentagon from 1959 until his retirement in 1965 as a lieutenant colonel.

He graduated from Utah State University, then received an M.A. in English literature from George Washington University in 1964. For the next 20 years Bill Carigan served as an assistant professor of English literature.

From 1985 until his recent death, on 6 January 1988, Bill Carigan has been an emeritus professor at Utah State University. He is the author of two novels, *The Flying Game* and *Staves for Louisville*.

Bill Carigan is buried at Arlington National Cemetery, Washington, D.C.

Sunflower University Press®
1531 Yuma (P.O. Box 1009), Manhattan, Kansas 66502-4228

ISBN 0-89745-09

08-CUA-359